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ECONOMY IN INCANDESCENCE ELECTRIC LAMPS.

IF the results of certain tests, made by Herr Goetz with the Cruto lamp, are to be relied upon, we may look hopefully forward to a greatly extended employment of incandescence electric lamps in the place of gas.

Herr Goetz has contributed to the *Centralblatt für Electrotechnic* a series of experiments which show some striking peculiarities possessed by the above-mentioned lamp. The Cruto carbon filament is deposited upon a very slender core of platinum. It was originally stated in descriptions of this lamp that the core of platinum was afterwards melted and dissipated by the application of a sufficient strength of current, and that there then remained in the completed lamp only a very fine hollow cylinder of pure carbon. It appears, however, which indeed always seemed likely to be the case, that the platinum core is not dissipated, and that the light-giving material is therefore a compound filament of carbon and platinum. A curious feature which had been noticed in connection with this lamp was its *increase* of resistance with increase of electromotive force. The particular lamps examined by Herr Goetz did not, however, show this to be invariably the case, as some of the filaments appeared to partake of the character of platinum alone, and to increase its resistance with increase of temperature, whilst others more resembled carbon, and decreased in resistance upon increment of temperature.

Herr Goetz does not appear to have gone beyond a luminosity of 17 candle-power in his experiments, but it is at comparatively low candle-power that economy is now desirable. The two leading systems of electric lighting by incandescence in this country are principally laid out for 16 or 20 candle-power lamps. It would not be safe to say that *less* than 60 volt-ampères would be expended in producing the respective candle-powers given above, of either system. Yet if the figures given by Herr Goetz are correct, the Cruto lamp gives a candle-power of 17 stearine candles for an expenditure of 32 volt-ampères, or 15¾ candle-power for 30·6 volt-ampères.

Considering, however, that the experiments on the Cruto lamps appear to have been limited to four specimens only, we do not suppose that the results of Herr Goetz will go for much in this country. Still they show, even presuming them to be picked samples of Cruto's system, a higher degree of economy than we can recall with any other type of lamp. Such a result, however, is only calculated to induce our English manufacturers to extra exertions towards a greater economy in incandescence electric lighting, and the researches of Herr Goetz will, therefore, not have been useless. The author of the experiments made some tests, terminated before completion however, by an accident, to determine if the change in resistance made any difference in the relations between light and power, and he concludes that it has no influence. The experiments, however, are within such narrow limits that we should not be inclined to put much faith in them. It is somewhat difficult to believe in the economy of a lamp, the resistance of which increases with additional electromotive force, and the excellent results obtained by Herr Goetz are probably due rather to the superior quality of the carbon used, which is deposited and not prepared by carbonising a vegetable substance, than to any merit possessed by the peculiar combination.

Indeed, if the platinum core *could* be dissipated or destroyed, leaving the light-giving material purely carbon, we should expect even better results than those quoted, provided the hollow cylinder would stand without its metal support. We have no information as to the lasting capacity of the Cruto lamps, but we need scarcely say that a long life is most essential to its success.

ON ELECTRICAL CONDUCTORS.*

BY WILLIAM HENRY PREECE, F.R.S., M. Inst. C.E.

(*Continued from page* 466.)

Gauge.—The vexed question of gauge as applied to wire has been fought with well nigh the same energy as that of railway gauges; the result is, that confusion has become more confounded. The various Birmingham wire-gauges—as various as the seats of manufacture of iron—were consolidated into one very useful gauge by the Society of Telegraph Engineers, but the Board of Trade has recently taken up the subject, and has issued another gauge, which has the merit of being authorised. It is fixed and legal, and therefore it must be accepted. However, it departs so seriously from all recognised gauges, and ignores so completely the metrical system, which is steadily and surely making its way into commercial use, that the Post Office authorities have decided to abandon a gauge altogether as applied to wires, and to define size by diameter and weight. Thus, in future, all copper wires will be known by their diameters in "mils,"* or thousandths of an inch, and all iron wires by their weights in lbs. per mile. The following Table gives the iron wires generally in use:—

Weight per Mile. lbs.	Diameter.	
	Inches.	Millimetres.
800	0·242	6·0
600	0·209	5·2
400	0·171	4·3
200	0·121	3·0
60	0·066	1·85

Steel wire is used for long spans, or for places where great tensile strength is needed; but it is for the external strengthening of deep-sea cables that steel wire is principally adopted. It was first employed in the Atlantic cable of 1865 for this purpose. It has since been generally used for deep-sea cables. The diameter employed is generally 0·099 in., and it is specified to bear a breaking-strain of 1,400 lbs., which is equivalent to 81 tons on the square inch. Steel wire has been produced giving a much higher tensile strength.

Compound Wire.—A compound wire of steel and copper was introduced in America about 1874. It had a steel core for strength, with an envelope of copper to secure conductivity and durability. It has a weight only one-third of an iron wire of the same resistance. It has been extensively tried in both hemispheres, but without success. It has been impossible to secure permanent adhesion of the envelope and its core. Moisture has in course of time entered, the steel has corroded away, and this even though the copper envelope has been deposited electrolytically. Light wires of great strength and of low resistance would be of inesti-

* The "mil" is one-thousandth of an inch.

mable value to the telegraph engineer, and the failure of the compound wire has been a source of great regret.

Recently a compound wire has been erected between New York and Chicago, 1,000 miles long, giving only 1·7 ohm resistance per mile. It has a steel core 0·125 inch in diameter, and is coated with copper electrolytically to a diameter of 0·250 inch. It weighs 700 lbs. per mile. It is very expensive. Hard-drawn copper, or silicious-bronze of a much lighter character would be equally efficient, at probably half the cost.

Bronze Wire.—Phosphor-bronze, whose hard mechanical qualities and great resisting powers are well known, was introduced for telegraph wire about five years ago. Several lengths were erected by the Post Office. Two long spans cross the channel that separates the Mumbles Lighthouse from the headland near Swansea. The object in view was to obtain great tensile strength with a power to resist oxidation, especially active where the wire is exposed to sea spray. This was done in 1879, and now, in November, 1883, not the slightest change is noticeable in the wire. But phosphor-bronze, though extensively used, has high electrical resistance; its conductivity is only 20 per cent. of that of copper. Moreover, the phosphor-bronze supplied was irregular in dimensions and brittle in character. It would not bear bends or kinks. A new alloy, silicious bronze, has recently been introduced to remedy these disadvantages.

due to changes of temperature is small. Its coefficient is 0·0004—copper being 0·0038—that is, ten times less. Its resistance per metre-gramme is 1·85 ohm, while copper is 0·144 ohm. The effect of age on German silver is very marked. It becomes very brittle. Mr. Willoughby-Smith* has found a similar change with age even with wire drawn from an alloy of gold and silver.

Conclusion.—It is evident from what precedes, that the form and character of electrical conductors must vary with the purposes for which they are intended. For submarine cables and for electric-light mains, where mechanical strength is not required, and where dimensions are of the utmost consequence, the conductors must be constructed of the purest copper producible, for copper is the best practical material at our command.

For aerial lines, where mechanical strength is essential, they must not only have great tensile strength, but in these days of high-speed apparatus they must have high conductivity, their dimensions must be such as to insure low electrostatic capacity, they must expose to wind and snow the least possible surface, and they must be as nearly as possible indestructible. Iron has hitherto occupied the field, but copper and alloys of copper seem destined to supplant that metal, and to fulfil all the conditions required in a more efficient way, and at no greater cost per mile.

EXPERIMENTS ON SILICIOUS-BRONZE WIRE.

Diameter.		Weight per Mile in Pounds.	Elongation Per Cent.	Breaking Weight in Tons per Square Inch.	Twists in 6 Inches.	Resistance in Ohms at 60° F.		Conductivity. Copper = 100.
Inch.	Mm.					Per Mile.	Per Foot-Grain.	
·080	2·056	102·65	1·5 : 1·0 2·0 : 2·0	27·61	13 : 16 23 : 35	8·6359	0·22258	94·616
·059	1·529	58·651	nil nil	29·368	21 : 25 27 : 53	15·437	0·22734	92·637
·044	1·133	32·31	nil nil	47·406	24 : 25 24 : 26	90·333	0·73285	22·826
·036	0·936	22·698	nil nil	50·07	23 : 19 11 : 22	157·39	1·4375	14·65
·081	2·072	102·17	1·5 : 1·0 1·5 : 1·0	29·022 27·47	47 : 19 16 : 20	8·5009	0·21807	96·571

Phosphor and silicious-bronze derive their names, not so much because the materials prefixed are mixed with the copper, but because they are used in the preparation of the alloy. Pure bronze is a mixture of copper and tin, and in the refining and mixing process phosphorus and silicium have the property of removing impurities, particularly the oxides, though doubtless some of the flux remains. Phosphorus has a most injurious influence on the electrical resistance of the alloy. Silicium is far superior; hence the silicious-bronze is preferable for telegraphic purposes. Its efficiency is very great; in fact, phosphor-bronze has disappeared for telegraph wire, and has been replaced by silicious bronze.

The electric resistance of silicious-bronze can be made nearly equal to that of copper, but its mechanical strength diminishes as its conductivity increases. Wire whose resistance equals 90 per cent. of pure copper, gives a tensile strength of 28 tons on the square inch, but when its conductivity is 34 per cent. of pure copper its strength is 50 tons on the square inch. Its lightness, combined with its mechanical strength, its high conductivity and its indestructibility render it eminently adapted for telegraphs.

The table above gives the results of some tests made by the Post Office upon specimens submitted for trial.

Long telegraphic lines, for which iron wire weighing 400 lbs. per mile is now used, can be made of bronze wire weighing 100 lbs. per mile, which would give higher electrical efficiency; and overhouse lines, for which steel wire is often used, can be replaced efficiently by bronze wire, weighing only 30 lbs. per mile, which would be almost invisible.

If overhead wires were erected of such a material, upon sightly supports, and with some method, there would be an end to the meaningless crusade now made in some quarters against aerial lines. These, if constructed judiciously, and under proper control, are far more efficient than underground lines. Corporations and local authorities should control the erection rather than force administrations to needless expense and to reduced efficiency by putting them underground. Not only do light wires hold less snow and less wind, but they produce less electrical disturbance, they can be rendered noiseless, and they allow existing supports to carry a much greater number of wires. Other bronzes have been tried, but without any evident advantage, either in quality or in price.

German Silver.—German silver is employed generally for rheostats, resistance coils, and other parts of apparatus in which high resistance is required. It consists of:—

Copper	4 parts.
Nickel	2 „
Zinc	1 „

It possesses great permanence, and the variation in its resistance

DYNAMO-ELECTRIC MACHINES FOR LABORATORY PURPOSES.

THE dynamo machine described below is calculated, says Mr. W. E. Fein, of Stuttgart,† to fill up a void which has become more and more perceptible between my small dynamo machine, driven by hand, as formerly described, and the larger sorts driven by steam power. It is applicable for both purposes. For hand use it is connected with a fly-wheel, supported by a cast iron pillar, and capable of being set in motion by a handle. If requisite for more prolonged use, or for a more complete utilisation of the machine a second handle may be fixed to the handle of the fly-wheel, so that the machine may be driven by two men. These handles can be shifted so as to increase or diminish their radius according to the power desired. The cast iron pillar and the dynamo machine are mounted upon one and the same foot of oak. The fly-wheel with its small driving drum are connected directly by a belt, so that the entire apparatus is conveniently arranged.

The machine is at all times ready for use, and offers a perfect substitute for galvanic elements which are troublesome to keep in order and circumstantial to manage. It is therefore an indispensible adjunct for the class-room and the laboratory, whilst its solid and strong construction admits also of continuous use for industrial purposes. A considerable number of these machines have been found to give satisfaction in workshops for galvanic precipitation, and even for small lighting installations.

The construction of these machines is carried out on the principles of my patent, No. 13,158 (German), and they are prepared in three kinds. The machine for quantitative currents is made with a coil of correspondingly strong wire. The medium make has thinner wires, whilst the third make, for producing tension-currents is provided with correspondingly fine coils.

* *Journal of the Society of Telegraph Engineers*, vol. ix., p. 49.
† *Zeitschrift des Electrotech*, Vereins in Wien.

By means of an accompanying rheostat, at the front of the upright column different resistances can be introduced by turning a small handle; these resistances correspond in the three classes of machines to the following values :—

Machine				Rheostat.				
Thick coils ...	0·1	0·3	0·5	0·75	1	1·5	2	ohms.
Medium „ ...	0·2	0·6	1	1·5	2	3·5	5	„
Fine „ ...	0·2	0·6	1	2	4	6	8	„

Above the journals of the fly-wheel there is fixed, at a convenient height, a small table for experiments, upon which are three wire clamps, the two anterior ones of which (1 and 2 in the figure) are in direct connection with the poles of the machine.

If these are connected with each other, and if the apparatus to be introduced is brought in contact with the clamps, 2 and 3, by means of an accompanying brass rod, the rheostat above-mentioned is brought into the lateral circuit, which is to be arranged when experimenting with apparatus possessing a great resistance

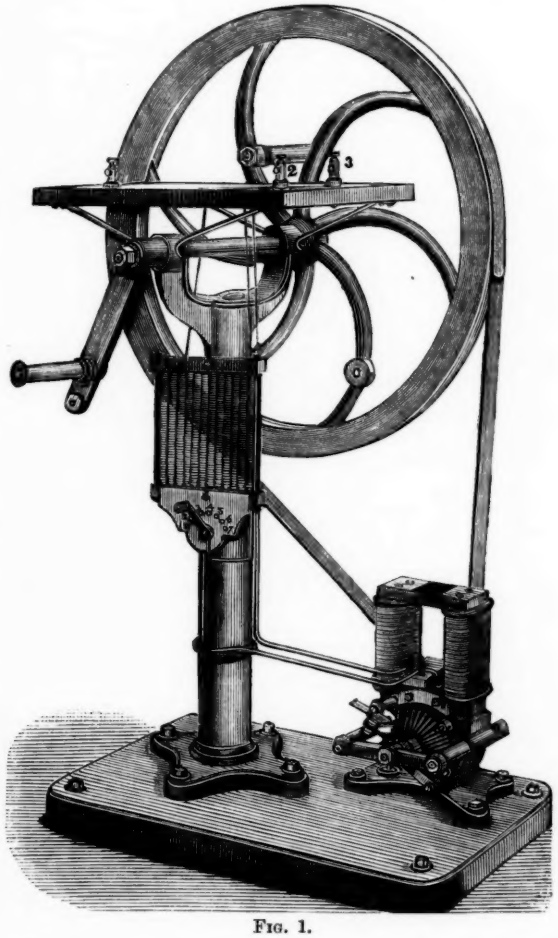


FIG. 1.

(single vacuum lamps, &c.), or in which the current is often interrupted (spark inductors, &c.)

The electric dimensions of these machines are, on an average :—

Machine.	Internal Resistance.	Strength of Current.	Tension.	Electro-motive Power.	External Resistance.
	Ohms.	Ampères.	Volts.	Volts.	Ohms.
With thick coils...	0·5	13	13	19·5	1
	0·5	18	9	18	0·5
	0·5	30	3	18	0·1
With medium coils	1·2	5·5	27·5	34·1	5
	1·2	15	15	33	1
	1·2	22	4·4	30·8	0·2
With fine coils ...	4·5	5	40	62·5	8
	4·5	7	28	59·5	4
	4·5	10	10	55	1

The fly-wheel should have a speed of 60—80 revolutions per minute, which can be kept up by two men with the double handle for any required length of time. A greater speed can be attained by the use of steam, &c., power, when the performance of the machine is proportionately greater. Experiments made with the machine, when driven by hand, give the following results :—

	Thick Coils.	Medium.	Fine.
Length of millimetres of platinum wire kept in bright ignition...	500	1,000	1,500
Diameter of wire in millimetres	0·7	0·5	0·3
Detonating gas evolved per minute, in cubic centimetres	300	250	150
Copper precipitated per minute in milligrammes	567	472	283

The machine with thick coils is best adapted for ignitions, evolution of gas, galvanoplastics, &c. The

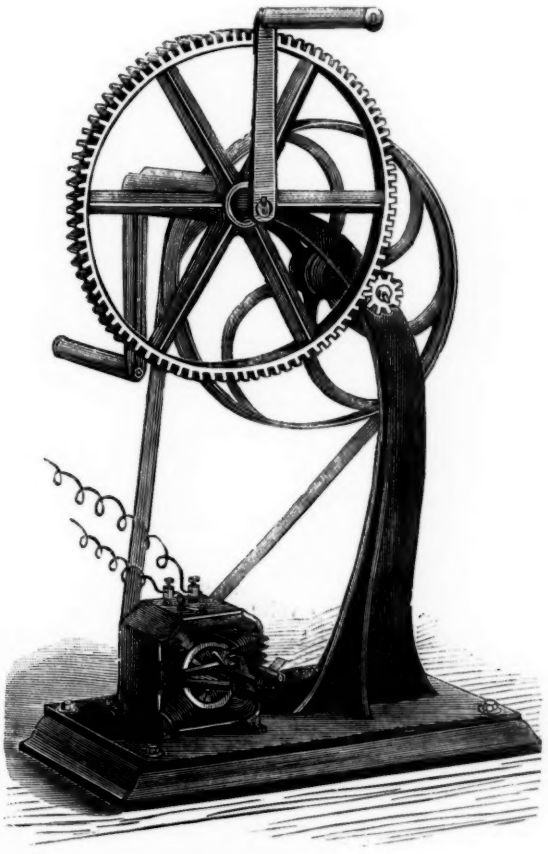


FIG. 2.

medium form is best adapted for the purposes of demonstration and serves for illumination with a small arc lamp, with one or two contact glow lamps or four to six vacuum lamps at 25 volts; for experiments on ignition and fusion, the transfer of power, charging accumulators, &c.

The machine with fine coils serves for the production of an intense arc light (250 volts), or to work three to four Swan lamps (40 volts), for which purposes, if driven by a small engine, it is quite sufficient to light up a small shop, &c.

With proper care accumulators can be easily charged with this machine.

It must not, however, be forgotten to cut off the connection between both apparatus before the rotation of the machine is slackened or interrupted.

Another machine, fig. 2, which we find illustrated in

the New York *Electrician*, is made by I. W. Colburn & Co., of Fitchburg, Mass. The object was to produce a machine capable of developing a current of sufficient quantity and intensity to meet the demands of any laboratory, and one absolutely free from the defects common in other machines of this class.

They furnish a current of enough power to operate three incandescent lamps, or one small arc light, sufficiently strong for illustrative purposes. The machine requires about two man-power to operate it at its fullest capacity ; but one man can develop sufficient electrical energy for general experimenting, the current developed being according to the power expended in operating the machine.

This apparatus, besides being very useful for general experimenting, is used to a considerable extent for practical purposes. A large number have been constructed for cautery use, and in every case are said to have given the greatest satisfaction.

With the use of this machine for cautery a great deal of annoyance is avoided by the surgeon having the operation in charge. It will heat, white hot, a long piece of No. 16 platinum wire.

The machine is made very rigid, and runs perfectly even and free from noise, the gears being cut.

As will be seen, the machine rests upon a heavy and strong iron base, with an upright column all cast in one piece. The weight of base and column is 375 lbs. There are bolt holes in base for securing the machine to the floor. The machine is so speeded that with a slight exertion on the part of the person operating the crank a very fast speed can be attained for the armature.

The machine can be run up to a speed of 1,800 revolutions per minute, and kept so without showing any heat in the armature or field-coils.

The frame of the machine is cast in one piece, which gives it absolute rigidness ; besides, the pole pieces of the exciting field are all secured to a solid composition ring, one on each side of poles. The machine is thus enabled to run perfectly free from vibration.

The armature is of the improved Gramme type. The current passes from the armature-coil through the insulated wire in the centre of the shaft to the commutator, which is outside the bearings. This gives easy access to the brushes, and they can be readily adjusted.

Unlike other machines, the commutator brushes, instead of being horizontally parallel, are set at an angle of 90° from each other.

The machine, when constructed for experimental purposes, is wound with quite small wire, and furnishes a current of 60 volts and 3½ ampères ; when constructed for cautery use it is wound with large wire, and then develops 4 volts and 50 ampères.

ON THE ELECTRICAL FIGURES OF CONDENSERS.

By E. VILLARI.

IF the free margins of a positively charged Leyden jar or of a plate of glass provided with circular coatings on both sides are powdered with a mixture of red lead and sulphur, there appears on the negative coating in connection with the ground, first a zone slightly covered with red lead, then a zone of about one centimetre in breadth, free from dust, and, lastly, a third zone covered with sulphur, sharply marked off inwardly, but gradually fading away on the outside. If a jar is charged negatively, the external zone is red and from the coating there run yellow ramifications through the neutral zone.

The zones which show discharges homologous to the adjacent coatings are produced by the electricity which has been transferred from them to the glass. The zones on a surface of a condenser which show discharges opposite in character to the adjacent coating are produced by the discharge of the opposite surface. In fact, these latter zones are almost exclusively formed around the coating in connection with the ground in consequence of the excess of charge of the opposite coating. If the surface of a plate of ebonite is struck with a cat-skin and the powder is blown away, there appears at the part which has been struck a red spot without an opposite zone, and on the opposite or positive surface there is found a much larger red spot, due to the influence of the part which has been struck.

In order to obtain the zones homologous to the adjacent coating it is requisite to experiment quickly and in dry air upon the coatings which have been directly charged ; otherwise the excess of the charge of this coating becomes dissipated and the efficacy of the opposite comes into play, the action of the former decreasing and the zone of the opposite charge appearing.

If a condenser or a Leyden jar is suddenly charged by connection with a charged battery, the glass sides of the former receive the spark discharges and are charged with the electricity of the coatings. On dusting, there are then formed upon the glass, figures which, according to the kind of the charge, are radiating yellow with a red lamettar halo, or red and lamettar with a radiating yellow halo.

Similar figures appear if a jar is overcharged, when single partial discharges pass from the coatings to the glass sides ; so that the charge of the charged coating decreases, that of the other coating being set partly at liberty and passing to the glass corresponding to the tracks of the partial discharge.

The figures on the side of the discharge are quite similar to those obtained by Antalik upon the surface of glass flasks.

The author then describes at length the phenomena observed on dusting a Franklin plate with small circular coatings.

He treats likewise of the figures which are formed upon the glass sides of a charged Leyden jar if dusted after discharge.

The figures can in general be deduced from the principle that when a coating loses electricity, electricity passes over to it from the adjacent glass, thus forming currents. On charging, there occurs an opposite movement of electricity from the coating to the glass, and lastly, the charges upon both sides of the glass act upon the mixture of powders. The streams indicated were observed with the galvanometer.

If a glass plate coated below, is dusted above with the mixture of red lead and sulphur, if the coating is connected with the external coating of a charged battery and the internal coating is discharged by a discharger upon the middle of the upper surface, there are formed upon it luminous rays which leave furrows in the powder and produce radiating figures. The positive figures have branches fewer in number but finely ramified. The negative figures have more gently curved arms with leaf-like terminations. All these differences vanish if a sufficiently dense powder is used.—*Wiedemann's Beiblätter.*

The Saigon-Haiphong Cable.—The bill for the laying of a cable between Saigon and Haiphong was discussed in the French Chamber on Monday. The scheme was rejected by the Chamber on the eve of the prorogation because the contract was with an English Company, and a Deputy had given a vague assurance that a French company might lay it. It was now agreed to without a division. The discussion of the bill, however, led to a scene between M. Cuneo D'Ornano and MM. Jules and Charles Ferry. M. D'Ornano complained of an English company benefitting by French colonial policy, and asked for a day's delay, on the ground that the brothers Ferry had seduced the majority. At the close of the sitting, M. Charles Ferry challenged M. D'Ornano, but the President, M. Brisson, brought all the parties together, and induced them to shake hands, on condition of the altercation being expunged from the official report.

THE ELECTRO-MOTIVE FORCE AND RESISTANCE OF "BUNSEN" CELLS.

IT is frequently required to know the current which can be obtained from "Bunsen" cells, on circuits of various resistances. This can easily be calculated from Ohm's law, when the electromotive force and resistance are known. Of course the external resistance must also be known.

The electromotive force of cells, as given in various books, seems very irregular; different figures being given by different authorities. This may be partly due to the fact that the electromotive force is constantly changing while the cell is working, being highest at first, and falling more or less rapidly according to the work the cell is doing.

The density of the acids or solutions used also affects the electromotive force, and as experimenters use different densities, this may also account for part of the irregularities mentioned.

The resistance of the cells keeps changing also, and very few books give any figures in regard to it. The electromotive force of cells is usually given in volts, and although the volt has an absolute value theoretically, it is practically a very uncertain unit.

The "Daniell" cell, charged with a solution of zinc sulphate, is frequently used as a standard of electro motive force; it is taken as 1·079 volt by many experimenters, but some regard it as ·955 volt, and others as 1 volt. This shows how uncertain the volt is as a practical unit of electromotive force.

The "Bunsen" cell is charged in a number of different ways, each of which has its advantages and disadvantages. The two commonest ways of charging is to fill the porous cup with nitric acid, or a solution of bichromate of potash in sulphuric acid. The zinc is put in dilute sulphuric acid.

To compare the merits of the two ways, one cell was set up charged each way, and they were left to run down on a resistance of about 1 ohm. The electro motive force, resistance and current were taken at intervals. The method of obtaining the electromotive force, &c., was as follows:—

The cells were left short-circuited on a resistance of 1·05 ohms, except when deflections were taken. A key was inserted in line, which kept the circuit closed, except when depressed, when it threw the cell direct on the galvanometer. By means of a switch the galvanometer could be connected to the terminals of 1 ohm in the line.

The galvanometer used was a high resistance reflector shunted so that a suitable portion of the current would go through it. A high resistance was also inserted in the galvanometer line.

The steady deflections are proportional to the current, but as it takes time to bring the spot to rest, the battery may have changed considerably when the deflection is obtained. The electromotive force of the cells begins to increase the moment the current is stopped.

The various swings or impulses are also proportional to the current, so to make the observations rapidly, before changes can occur in the cell, the first swings were taken.

For a standard cell I used a "Daniell," containing a saturated solution of copper sulphate and a solution of zinc sulphate, prepared by dissolving 1 part of zinc sulphate in 10 of water. Pure chemicals were used in this cell. The zinc was not amalgamated. The galvanometer was set so that the standard cell gave a first swing of 100, therefore each deflection meant ·01 of the standard cell.

It will be seen from the above that the deflection of the cell equals the electromotive force, that of the ohm equals the current. The electromotive force divided by the current equals the total resistance; subtracting from this the external resistance 1·05, we have left the resistance of the cell in ohms.

The dimensions of the cells were: glass jar, 10 cm. diameter, 12·5 cm. high; porous cups, 5 cm. diameter, and zincs, 6·5 cm. diameter. The carbons were 2 × 1·5 cm.

Each jar contained 400 cu. cm. of dilute sulphuric acid (1 to 12 by volume). No. 1 contained 100 cu. cm. of nitric acid (sp. gr., 1·35) in the porous cup; No. 2, 100 cu. cm. of chromic solution, prepared by dissolving 30 g. of bichromate of potash in 240 cu. cm. of water, and then adding 50 cu. cm. of sulphuric acid. The zincs were amalgamated the day before using; they were also weighed, so that the amount of local action could be ascertained. The cells were left charged 1¾ hours before using. External resistance was 1·05 ohm.

The electromotive force is given in terms of the "Daniell" cell; the resistance in ohms. The current answers the formula $\frac{E}{R}$.

After Working.	No. 1, Nitric Acid.			No. 2, Chromic Solution.		
	E. M. F.	Current.	Resist.	E. M. F.	Current.	Resist.
	1·71	1·21	·35	1·83	1·22	·45
5 minutes	1·70	1·21	·34	1·40	·90	·50
10 „	1·69	1·21	·33	1·32	·86	·48
15 „	1·69	1·20	·34	1·29	·86	·45
30 „	1·69	1·21	·33	1·24	·82	·46
45 „	1·68	1·21	·33	1·20	·79	·47
1 hour	1·69	1·23	·32	1·17	·79	·43
1½ „	1·68	1·24	·29	1·13	·76	·44
2 „	1·69	1·25	·29	1·10	·74	·43
3 „	1·69	1·26	·28	·99	·67	·42
4 „	1·68	1·26	·27	·90	·60	·45
5 „	1·65	1·23	·28	·76	·49	·50
6 „	1·64	1·22	·28	·61	·37	·60
7 „	1·64	1·21	·29	·48	·29	·60
8 „	1·64	1·21	·29	·43	·25	·67
9 „	1·63	1·20	·29	·41	·23	·73
11 „	1·60	1·17	·30	·35	·20	·70
22 „	1·45	·91	·53	·31	·17	·77
23 „	1·36	·83	·46	·31	·17	·77
24 „	1·17	·73	·54	·31	·17	·77
25 „	1·02	·63	·56	·31	·17	·77
26 „	·90	·55	·57	·31	·17	·77
29 „	·43	·25	·66	·31	·17	·77
30 „	·42	·24	·69	·31	·17	·77
31 „	·41	·23	·72	·31	·17	·77

The current here taken will dissolve in 1 hour 1·32 grains of zinc.

Zinc dissolved in cell No. 1 = 48·241 g.
„ „ by current = 37·026 g.
„ „ by local action = 11·215 g.

Zinc wasted is about 30 per cent. as much as utilised.

Zinc dissolved in cell No. 2 = 13·226 g.
„ „ by current = 11·128 g.
„ „ by local action = 2·098 g.

Zinc wasted is about 19 per cent. as much as utilised.

The above figures, says Mr. Geo. G. Grower in Van Nostrand's *Magazine*, show that although the electromotive force of the cell with the chromic solution is at first higher than with nitric acid, it immediately falls far below it.

The nitric acid cell holds its electromotive force well until nearly exhausted. With nitric acid the resistance is less and the current stronger and steadier than with chromic solution.

The waste of zinc due to local action appears to be more with nitric acid than with chromic solution.

The nitric acid cell is far superior to the chromic as far as the work is concerned, and if it were not for the disagreeable and unhealthy fumes it gives off, would be used in nearly every case.

Institution of Civil Engineers of Ireland.—At the annual meeting of this institution, held in Trinity College, Dublin, last week, the Mullins Medal was presented to Mr. Angelo Fahie, C.E., M.S.T.E. and E., for his paper on "Magneto and Dynamo Electric Machines," read during the last session.

DANCHELL'S ELECTRIC RAILWAY.

As we have already mentioned in a former number, this railway aims at high speed with a comparatively light load, instead of low speed with a heavy load. The distinguishing feature in its construction is, that it has only one rail for the train to run on, instead of two; that it is balanced by another rail over head, which has at the same time the function of conducting the electric current, and it prevents the train from leaving the metals, no matter at what speed it may travel.

The object of running the train on a single rail, instead of two, is to reduce the friction to a minimum. Two wheels on the same axle give rise to an unavoidable sliding, jerking, and knocking upon the rails, and consequently too much friction, and wear and tear, which is avoided by the one rail principle.

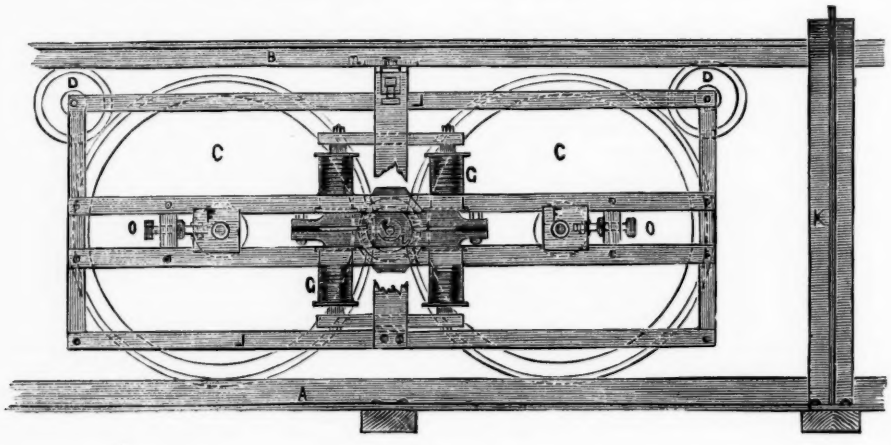


FIG. 2.

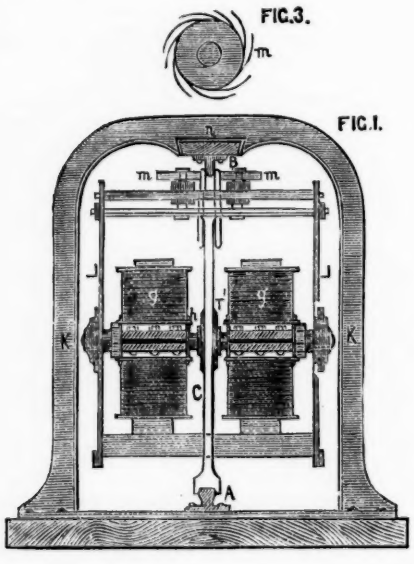


Fig. 1 shows the cross section with, A, the carrying rail, and, B, the guiding rail, which are both fixed to the support, K. The upper rail is fastened to stays of wood driven into a notch of the support at *n*, and is then insulated from the metal of the support.

Fig. 2 is a longitudinal section, showing the driving wheels, C, and the guiding wheels, D. The frame, L, which is carried by the axles of the driving wheels, C, carry in their turn the motor, G, and the guiding wheels, D. The electric current is communicated to the rail, B, from a dynamo, by means of a copper wire, and from thence to the two rotary brushes, the construction of which is shown on a larger scale in fig. 3; from these brushes the electric current is again conducted by means of wires to the motor, G, the armature of which is made to revolve, and cause the motion to the driving wheel, C, by means of a friction roller on the axle of the armature. In order to secure the proper grip of the friction roller on the driving wheels, the bearings of the axles are made adjustable by means of the screws, *o*. A model track of 60 feet in diameter was erected in Maidstone, some months ago, and we then had an opportunity of privately inspecting Mr. Danchell's system.

We shall hope to keep our readers well informed on any further experiments which may be made with this method of constructing an electrical railway.

We believe that hitherto the dynamos and motors of Mr. Jarman have been employed in connection with Mr. Danchell's railway.

THE DISCOVERY OF ELECTRO-MAGNETISM.

IN *Cosmos les Mondes* (No. 9, June 30th last), Dr. Tommasi discusses the question whether the discovery of electro-magnetism can be rightfully attributed to the Danish *savant* Oersted, as it has been universally done hitherto.

It is probably not known that as a result of studies carried on since 1859, the Italian Professor Zantedeschi seems inclined to ascribe the fundamental discovery of electro-magnetism to his countryman Romagnosi.

Although Tommasi himself admits that Romagnosi, in spite of the favouring zeal of Zantedeschi, has not hitherto been recognised as the discoverer of electro-magnetism, he believes he may gain adherents for this view by a publication of an extract from the *Ristette dei Foglietti universali di Trento* of August 3rd, 1802; and as at present a great number of scientific men are assembled in Vienna in a kind of congress by occasion of the Electric Exhibition, he thinks that the present time is most favourable for solving the problem.

Accordingly, Dr. Tommasi requested the managing committee of the Exhibition to lay the affair before the assembled scientists and to submit especially the subjoined questions to their consideration.

The above-mentioned extract from the Trent paper is as follows:—"The Councillor Giovanni Domenico Romagnosi, resident in Trent, hastens to lay before the physicists of Europe an experiment concerning the influence of the galvanic fluid upon magnetism. After he had fitted up a Galvani's column consisting of discs of copper and zinc between which were interposed

circles of flannel, moistened with a dilute solution of ammonia, he attached to it a silver thread interrupted in several parts like a chain. He then took an ordinary magnetic needle, fixed in a wooden prismatic box like the needle of a ship's compass, and after removing the glass lid, he placed the needle upon a glass insulator in the neighbourhood of the column. He then took up the interrupted silver thread by means of a glass rod and brought it to the end or the button of the magnetic needle. After a contact of several seconds the needle diverged several degrees from its polar position. If the silver thread was then removed, the needle remained in the position it had taken, and if the silver thread was again brought near, it again diverged farther, always remaining in the position which it had taken at the last approximation; it seemed as if its polarity was entirely destroyed." In order to bring it back to its original position, Romagnosi proceeded as follows :—He pressed the edge of the box with both hands between the thumb and first finger, avoiding any shaking, and held the box so for a few seconds. The needle then returned to its former position moving like the second's hand of a watch, seeming to have thus recovered its polarity. This experiment was made in the month of May and was repeated in the presence of several witnesses.

Dr. Tommasi draws up as follows the questions which he wished to be answered by the physicists assembled in Vienna :—

1. Should the merit of having for the first time observed the deviation of a magnetic needle under the influence of the galvanic current be ascribed to Oersted or to Romagnosi ?

2. Had Oersted knowledge of Romagnosi's experiment when he published his discovery of electro-magnetism ?

3. Had any other physicist a share in the discovery ?

The affairs with which the *savants* assembled in Vienna were engaged were of a very different nature from the matter which Dr. Tommasi had thus brought forward. The actual questions for whose solution so many motors dynamos, lamps, and other apparatus had been brought together seemed for the present more important than disputes concerning priority, which must involve study and, in consequence, must demand time and leisure—scarce articles in Vienna during the time of the Exhibition. It seemed therefore preferable to leave for the present the discussion of the question to the Danish and Italian *savants*.

For this purpose, application was made to Captain Lund, the Danish Commissioner at the Exhibition. Dr. Tommasi's paper was handed over to him and he was invited to place the defence of the Danish claims to the honour of the discovery in proper hands. Captain Lund, after his return home sent, a short time ago, a letter which he had received from Prof. Holton, defending with much learning the claims of Oersted. In this letter Holton recapitulates the circumstances of the case and the account of Ramagnosi's experiment, as taken from the Trent paper by Zantedeschi and as recently published by Dr. Tommasi.

He then gives the following decision :—

"In all this, according to Tommasi's own description, there is but a very slight resemblance to the electric phenomenon discovered by Oersted. There was here no current, as both the needle and the conductor were insulated. There was here also nothing of the polar behaviour manifested in electro-magnetism. The deviation of the needle persisted after the removal of the conductor, which is not the case in the action of the current upon the needle. It is probable that Romagnosi sought to produce an electroscopic action of the column by means of the conductor upon the needle, but, according to Tommasi's own account, he did not discover electro-magnetism. The question has been previously discussed in the "Fortschiette der Physik" (Vol. xv., p. 473), and in a report published of Prof. Goir. In both cases the authors decided in favour of Oersted, as against the somewhat strained pretensions of Zantedeschi."—*Zeitschrift des Electrotech, Vereins in Wien.*

NOTES.

Electric Lighting.—Last Friday the Italian opera at Paris gave the first performance of Dubois' ballet, *Farandole*. In the second act a new application of electricity is brought out. The scene is the interior of the Amphitheatre at Arles, by moonlight, and at the proper moment, on pressing a button, the stars worn by the *danseuses* on their brows were illuminated by electric light, and the will-o'-the wisp dance produced a very happy effect. Considerable use was also recently made of electricity at the Vienna Exhibition, where a ballet was performed, the chief features of the entertainment being the introduction of electro-magnets, dynamo machines, telegraph apparatus and telephones, which were dragged on the stage by fantastic goblins, and handled by the graceful *danseuses* with as much ease as if they were especially trained in the mysteries of electricity. One of the prettiest scenes was the telegraph polka, which was danced by two ladies in the costume of telegraph boys. An amusing adaptation of the incandescent light has likewise been made at the Bijou Theatre, Boston, in the last act of *Virginia*. The two red horns on the devil contain 16-candle lamps, which, being connected with the Edison system in the theatre, are lighted when the devil disappears upward, producing a striking effect.

A contemporary says, an electric arc lamp, which has been invented and patented by Messrs. Clark and Bowman, was publicly exhibited for the first time last week at 411, Brixton Road. The main feature of the lamp is said to consist of an improved form of clutch, in which the carbons are fed by very small impulses, and the length of the feed is determined by the clutch. The feed can be regulated at will while the lamp is burning. As the length of the arc increases it immediately feeds its prearranged length, and then locks itself until the arc has again increased. Among other advantages the inventors claim that the lamp contains less moving parts than any other, while the whole of its moving parts can be removed or replaced while the lamp is burning without shutting off the current. The lamp is stated not to be affected by dust, heat, or atmosphere, and will burn from six to 24 hours with one pair of carbons, and will moreover run in any position. It has been successfully tried on the Brush, Gramme, and other dynamo machines.

Messrs. Faraday & Son have lately brought out some encaged Swan lamp fittings with safety fuses for factory use. These have been applied successfully in some of the large cotton factories in the north. Messrs. Faraday are also engaged on some special fittings for Messrs. Siemens Bros. at the Forth Bridge Works.

The St. Helen's (Lancashire) Corporation, and the Corporation of Bury St. Edmunds, are applicants for Provisional Orders for electric lighting. The Telegraph Construction and Maintenance Company and the West London Electric Lighting Company are applying to the Board of Trade to transfer to them the powers granted to the Edison Company in respect of parts of the parishes of St. James, Westminster, and St. Martin-in-the-Fields.

The following appears in *Martineau and Smith's Hardware Trade Journal*:—"An intelligent lad of 17, with a decided mechanical turn of mind, has been teaching his elders how to 'light up.' This youth, a son of Mr. E. Storey, ironmonger, of Oundle, has for 12 months past lit up his father's shop and premises, economically and well, with the electric light, and gas, we understand, has not been in use there since. To the credit of young Storey it must be added that he also made the engine which drives the electric lighting machinery."

The Ball Electric Manufacturing Company, of Reading, Pa., has applied for a charter. The company will manufacture the electric inventions of Messrs. Charles E. and R. E. Ball, of New York, and W. H. Spang, of Reading, which consists of dynamo

electric machines (already described in our columns), arc and incandescent electric lights, and electro-motors.

Tenders are invited for the lighting by electricity of the naves and centre transepts of the Crystal Palace; only the arc light is to be used.

The General Purposes Committee of the Corporation of London will sit at the Guildhall on the 23rd of January next for the purpose of receiving and considering tenders for lighting the interior of the Mansion House by electricity. Tenders are to be delivered personally on the day mentioned, between the hours of 12 and 1.

As recently notified in these columns, the Streets Committee of the Commissioners of Sewers recommended that the City be divided into five districts for the purpose of electric lighting, and tenders are now invited for the latter work; these are to be delivered at the Guildhall before 2 p.m. on the 25th January next, on which day the Streets Committee will meet to consider the same.

Telephonic.—An automatic resistance cut-out for telephones has recently been patented by Messrs. Charles D. Wright and Charles A. Fisher, of Petersburg, Ill. The object of the invention is to provide an improved attachment for telephone instruments, so that all the telephones on the line between the two instruments may be cut out automatically, and whereby the circuit will be materially shortened and the resistance decreased correspondingly. The same inventors have obtained a patent for a cut-out for telephones, and the invention consists in a telephone cut-out constructed with a clockwork mechanism which is released by means of an electro magnet as soon as the current passes through the instrument, whereby a lever resting on a notched wheel of the clockwork mechanism is brought in contact with a spring connected with one of the binding posts, so that the current will be short-circuited, and will pass through the instrument without passing through the transmitter or receiver, whereby the telephone can be cut out.

The Chicago Telephone Company has paid an extra dividend of 4 per cent. This makes 16 per cent. paid by this company in dividends this year. The stock of this company is quoted at 285.

It is said that the Mexican Government is interesting itself in the telephone, and building lines for the Mexican Telephone Company without cost to the latter, and at the same time paying a royalty for the instruments used. The earnings are now largely in excess of operating expenses, but the surplus for the present goes into construction. The company is out of debt, and has a working surplus in the treasury.

The Telephone in Belgium.—Consul Gratton, in his annual report on the trade of Antwerp for 1882, says:—An important step has lately been made in this country towards the application of the telephonic process to long distances. The result of the measures now about to be taken will be that very shortly all the principal towns in Belgium will be placed in communication with each other—an advantage the benefit of which, to business men and to the public generally, cannot easily be over-estimated. A temporary experiment, by arrangements extending over a period of five days, was made last month between Antwerp and Brussels, the result of which is described as having been highly satisfactory. The subscribers were able to communicate with one another with perfect ease, and a voice of average strength could be distinctly heard at each extremity without any unusual effort being required on the part of the speaker. Communications have been exchanged between Brussels, Antwerp, and Linden by wire and cable, and it is also said that arrangements will be speedily entered into with Holland, by means of which a close system of telephonic inter-communication will be established between the two countries. The system adopted in Belgium is that introduced by M. Van Rysselberghe.

The United Telephone Company.—This company is applying to Parliament for powers to break up streets, erect posts on, and to lay or carry wires for telephonic communication under or over any land, house, street, or other place within the City of London and the limits of the metropolis.

Tomlinson v. the Lancashire and Cheshire Telephone Company.—Last week in the Chancery Court sitting at Liverpool, before Vice-Chancellor Bristowe, this case was heard. The action was brought to restrain the defendants from placing wires on the plaintiff's property, to remove wires already placed, and for damages. Mr. Maberley opened the case, and stated that the defendant company, without plaintiff's authority, had placed three wires on the plantiff's property. Mr. Clare for defendants, said he was prepared at once to give his friend all that he could possibly get if he proved the case. Mr. Maberley preferred to state his case; since the action had been brought defendants had been on plaintiff's roof and cut the wires, so that they were now hanging loose. The Vice-Chancellor: Those loose swinging wires are most dangerous things. No one can have any idea of the power of those wires in motion. Mr. Clare: I quite admit that my friend is entitled to every thing he asks. Mr. Maberley said his client wished to have the order of the Court; and therefore it was necessary that the facts should be stated. Ultimately the matter resolved itself into a question of costs, and His Honour in delivering judgment, said as to the cost of the present hearing, he would express regret that the defendants had not replied to the plaintiff's letter of the 5th inst., and intimated that they would not require him to call witnesses, &c. He therefore declined to make any order as to those extra costs. The order would, of course, be in the plaintiff's claim.

"Expanded" Telegrams.—At the Central Criminal Court on Thursday last week, Mr. W. J. Simpkin and Mr. Edward Dalziel, publisher and proprietor of *Judy*, were charged with publishing a false and defamatory libel concerning the Central News Telegraph Company, Limited, which libel was contained in a cartoon, headed "Bogus Telegram Agency," recently published in the serio-comic journal mentioned, and certain comments in the same issue under the title of "Political Palaver." These, Mr. Waddy, counsel for the prosecution, contended, not only impugned the accuracy of the Central News telegrams, but implied the concoction and dissemination of fictitious intelligence by the agency. Evidence was given by sub-editors of the Central News, who proved the receipt of "skeleton" telegrams of about a dozen words which they expanded into several hundreds and issued to the newspapers; this, they stated, with nothing that was not literally accurate. The Recorder observed as his opinion that the statements in the alleged libel were only fair criticisms, and, the jury concurring, a verdict of "not guilty" was returned.

The Bennett-Mackay Cables.—Recently, we mentioned a rumour that the manufacture of these cables had been stopped, and took occasion then to deny the truth of the statement. The same statement is again being made, and it is asserted that Messrs. Bennett and Mackay are not now pulling together. We hear likewise that Mr. Mackay arrived in Liverpool on Wednesday, having come over in the s.s. *Alaska*.

The Suakim Cable.—A Reuter's telegram from Cairo, dated the 14th instant, says:—"To-day a convention was concluded with the Eastern Telegraph Company by which the latter agree to set about laying a cable to Suakim without delay. It is anticipated that cable communication will be established in ten days' time." The *Standard's* correspondent, telegraphing from Cairo on Tuesday, the 18th, says:—"The contract with the Telegraph Company has not yet been signed."

Paper Electric Insulator.—An Electric Insulator is now constructed of paper pulp. Liquid silica, or silicon, is used as a cementing agent, and when these constituents are combined in proper proportion, a superior insulator is said to be produced, covering at once, all the ground heretofore almost monopolised by the different forms of glass. This improvement is the subject of a patent recently granted to Charles C. Hinsdale, Cleveland, Ohio.

The Philadelphia Electrical Exhibition.—A Washington dispatch says that Secretary Folger, of the Treasury, has issued a circular to Collectors of Customs and others relative to the exhibition of electrical apparatus, &c., to be held at Philadelphia by the Franklin Institute, in which he directs that invoices of all articles imported for exhibition shall recite the fact that the goods embraced therein are intended for the exhibition, and each shipper shall be required to make his invoice in triplicate, giving a description of his goods, their value, and the marks and numbers thereon; but any number of such invoices may be embraced in one declaration by the agent, such declaration to be taken before a consular officer of the United States, and certified to in the usual manner. Articles intended for this exhibition, and arriving at the ports of Boston, New York, Baltimore, San Francisco, or New Orleans, or any port on the Canadian frontier at which goods may be shipped for immediate transportation under the Act of June 10, 1880, may be shipped by bonded common carriers from the port of first arrival to Philadelphia. Such of the instruments of precision as may require verification and adjustment for adaptation to the scientific purposes of the exhibition in advance of its opening, may be delivered to the Franklin Institute for such preliminary adaptation upon receipts signed by the president or vice-president of the Institute.

Dryer's Conduit for Electric Wires.—An improvement in conduits for electric wires has been patented by Mr. Bernhard A. Dryer, of New York City. The conduit is designed to be placed in the street with its vertical side against the curbstone, the cover forming the gutter, or it can be placed under the outer part of the sidewalk, its vertical side forming the curbstone, and the cover the outer part of the sidewalk, the whole being designed to fully protect the wires and give easy access thereto.

Electrical Companies' Shares.—At the fortnightly sale of the Stock and Share Auction and Advance Company on Thursday, the highest bid for the Jablochkoff Electric Light and Power Company's shares was 12s. 6d., and, the reserve price being 25s., the shares were bought in; 8s. was offered for the shares of the Electric Sun Lamp and Power Company, for which 10s. would have been taken; an offer of 8s. 6d. was made for the whole of the 12 lots of the Electric Insulator Manufacturing Company's shares, provided they were as described in the catalogue, 25 £5 fully-paid shares to the lot: doubt existing, no sale took place; 3s. 6d. was required for the Maxim-Weston Electric Company's shares, but only 3s. was offered.

The Mid-London Electric Railway.—At a Court of Common Council held last week, in answer to Mr. Wheeler, the Remembrancer said that with regard to the Bill of the Mid-London and Electric Railway from the Marble Arch, through Holborn, Skinner Street, Cheapside and the Poultry, to the Royal Exchange, the notices unquestionably provided that the use of the soil underground and the erection of ventilators should be taken without compensation; that only parts of houses should be taken; and that the Corporation and Commissioners of Sewers should subscribe to the scheme. The vestries and the occupiers of premises had held meetings and protested against the scheme. He believed the bill referred to was the same that was presented last year, and which never got beyond its preliminary stage. Mr. Wheeler said it was proposed, he understood, to take shops for stations, and to have lifts for the lowering of the passengers when going by train. Mr. Thomas Beard observed that the railway, as proposed, would be 60 feet underground. Mr. Wheeler hoped the Remembrancer would watch the introduction of such a bill, and bring it to the immediate attention of the court.

A meeting of the inhabitants of Oxford Street was held on Monday, at the Court House, Marylebone Lane, to oppose the making of the Mid-London Electric Railway, proposed to be run under Oxford Street, from the Marble Arch to Tottenham Court Road, thence extending to the Bank. Representatives from most of the leading firms were present, and took part in the proceedings. A unanimous resolution was carried, expressing the indignation and alarm of the ratepayers of Oxford Street, and the opinion that the railway would be a scheme for private advantage; was not necessary for public use; and its formation would involve such an interruption to business as would probably ruin many traders along the route. A committee was formed to take steps to offer strenuous opposition to the scheme, and this committee was instructed to communicate with the freeholders, public bodies, Metropolitan Board of Works, and others whose interests might be threatened, A guarantee fund was formed, and four gentlemen present pledged themselves to the extent of £500 each, as they were desirous of showing that they really meant to fight.

Mr. Sydney Morse, solicitor for the Bills, in the *Daily Telegraph* of Thursday, points out that according to certain clauses in the Bill deposited in the House of Lords on December 17th, it is provided that the time, during which the removal of soil and material should take place, should be subject to the approval of the road authorities; that steam power be not used; and that no shaft or opening be made in any road except Honey Lane.

Royal Institution of Great Britain.—Professor D. E. Hughes, F.R.S., M.R.I., is to treat on "The Theory of Magnetism," which he will illustrate by experiments, before this institution, on Friday, February 29th, 1884.

Overhead Wires Again.—At about six a.m., on Wednesday, a shocking accident occurred in connection with a fire at Messrs. Wild and Sons' Mill, Oldham. The fire brigade were taking a fire escape to the mill, when it came in contact with a telephone wire, attached to the mayor's house. The telephone wire pulled down four yards of heavy coping stone, severely injuring eight persons, three of whom will not survive.

The Simplex Electric Light and Plant Company.—We hear that this company did not proceed to allotment, scarce any applications, and those only for small amounts, having been made.

St. George Telephone Company, Limited.—A petition for the winding up this company has been presented by Messrs. E. J. Paterson & C. F. Cooper, electric light and power and telephone engineers, of 76, Little Britain, E.C. The hearing will take place before Mr. Justice Chitty on the 12th January, 1884.

Launch of a Ship by Electricity.—The launching of H.M.S. *Imperieuse* was successfully accomplished, at Portsmouth, on Tuesday, electrical arrangements, under the direction of Mr. H. Lane, playing an important part in the proceedings. By pushing an electrical button, water was admitted to the dock, floating the vessel; the manipulation of a second button shattered the bottle of wine, christening the vessel; whilst on a third button being pushed the hawser holding the ship to the stage was released, and she was hauled out of the dock.

The Jablochkoff Electric Light and Power Company.—A petition was presented in the Chancery Division of the High Court of Justice, before Mr. Justice Pearson, on Saturday, the 15th instant, for the winding-up of this company by Mr. Rivers Everitt, a holder of 19 shares in the company, and by Mr. F. Dovey, who was a creditor for £43 15s., and who had a further claim for £1 16s., which was disputed. Two other petitions had been presented, but one was dismissed and the

other withdrawn. The ground of the petition was that the company was unable to pay its debts, and was not in a position to carry on its business, Mr. Justice Pearson said there were two petitions presented for the winding-up of this company on the 9th of November, one by a creditor named James Willing and another by Pennington, a shareholder. Mr. Willing's debt was paid shortly after the petition was presented, and Mr. Pennington's petition was withdrawn. Under these circumstances the present petition was presented by Mr. Rivers Everitt, who was at the present time a holder of 19 £5 shares in the company, and a Mr. Dovey, who was, at the time the petition was presented, a creditor for the sum of £43 15s. for rent, and for a further claim of £1 16s., which debt was for insurance, and was contested, but whether due or not the Court could not give the relief asked by a creditor for that amount. Then as to the claim for the £43 15s., it appeared that a cheque had been sent to Mr. Dovey for this sum on the 16th of November, and he refused to obtain payment for it, but he did not return the cheque, and there was no suspicion that it would not have been paid if presented. Under these circumstances, there appeared to be no justification for the presentation of a third petition, and it failed altogether. Then as to the petition of Everitt, he was the holder of 19 shares, and his Lordship was bound to consider the position of the other shareholders as well as his; and it appeared he was the only one of the shareholders who asked for a winding-up order, and he was not supported by any of the others. Besides this, his Lordship was not satisfied that the company was in such a position as to be deemed insolvent. The petition must, therefore, be dismissed with costs.

The Society of Engineers.—A course of lectures "On Electrical Engineering," is to be given in the Reading-room of the Society of Engineers, 6, Westminster Chambers, S.W., by Mr. John C. Fell, according to the following syllabus :—

Lecture I. (January 7th).—Electricity—Mechanical theory—Magnetism—Electro and permanent magnets—Inductive discharge—Spark igniters, and character of the current.

Lecture II. (January 14th).—Galvanic electricity—Commercial galvanic batteries—Varieties—Arrangement of batteries for maximum effect—Internal resistance—Electrolysis—Electro-plating.

Lecture III. (January 21st).—Dynamo-electricity—Current generation—Units of current strength and resistance—Dynamo-electric machines—Varieties—Modern improvements.

Lecture IV. (January 28th).—Electric arc lights—Varieties—The Gramme—The Weston—The Brockie—The Brush, &c.—Automatic adjustments—Heating and lighting effects of current—Conductors and dielectrics.

Lecture V. (February 11th).—Electric incandescent lights—Varieties—The Edison—The Swan, &c.—Current resistances—Sub-divisions of current—The filaments—Shunts—Safety junctions.

Lecture VI. (February 18th).—The electro-motor—Essential principles—Varieties—The Siemens—Ayrton and Perry's—Modes of application—Electrical haulage—The transmission of electrical power.

Lecture VII. (February 25th).—The accumulator—Secondary batteries—Varieties—The Faure, &c.—Applications to electric lighting—To launches, railways, and tramways—Ammeters—Voltmeters, &c.

Lecture VIII. (March 10th).—Thermo-electricity—Direct conversion of heat into work—Thermo-piles—Telephony—The Gower-Bell—The Edison—Transmitters and receivers—Primary and secondary currents.

The Institution of Civil Engineers.—The ballot for the council, for 1884, of the above institution has resulted in the election of Sir J. Bazalgette as president. The new members of the council are Sir H. Bessemer, Sir J. N. Douglas, Mr. C. D. Fox, and Mr. W. H. Preece; the latter gentleman is, we believe, the first telegraph engineer who has sat in the council of the institution.

A Bohnenberger's Electroscope of very great and constant sensitiveness.—By L. Palmieri.—The author renders dry columns very constant by a coating of lacquer and uses them in the construction of the above-named electroscope; he recommends them also for charging the Thomson-Mascart electrometer.—*Wiedemann's Beiblätter.*

NEW COMPANIES REGISTERED.

Hungarian Gold and Silver Reduction Works, Limited.—Capital £250,000, divided into 33,333 preference shares of £5 each, and 83,335 deferred shares of £1 each. Object :—To purchase from the Electro-Amalgamator Company, Limited, the letters patent for Austria and Hungary granted in respect of Barker's patent electro-amalgamating process. The patent is dated 1st May, 1883, and numbered 3,839 (16,878). Signatories (with one preference share each): W. J. Tanner, 21, Old Square, Lincoln's Inn; C. G. Robertson, 14, Throgmorton Street; H. Beckwith, Lime Grove, Uxbridge Road; T. R. Hewitt, Kensington Palace Mansions; C. F. Jahn, 145, Wilberforce Road; R. Stuart Gladstone, Tower Chambers, Moorgate Street; Captain F. H. Lyell, Bickley, Kent. Directing qualification, £500 of the nominal share capital; remuneration, £250 per annum to the chairman and £200 per annum to each of the other directors. Registered 14th inst., by Norton, Rose & Co., 24, Coleman Street.

British and Foreign Telephone Company, Limited.—Capital £50,000, in £1 shares. Objects :—To acquire and work inventions relating to telephonic and other electrical and mechanical apparatus, and for such purposes to adopt an agreement of the 11th inst. between George Shenton and Alexander Thomas Angus. Signatories (with one share each): Arthur Eldridge, 25, Cadogan Terrace, South Hackney; C. W. Dillon Sturgeon, 48, Lincoln's Inn Fields; W. Holman Suckling, 10, New Broad Street; W. Baker, St. Clement's House; E. Brooks, 85, Gracechurch Street; J. Fryer Sprague, 25, Cantlowes Road, Camden Town; W. Ruthven, 29, Paignton Road, Stamford Hill. Registered 15th inst., by Campbell, Reeves & Hooper, 17, Warwick Street, Regent Street.

OFFICIAL RETURNS OF ELECTRIC COMPANIES.

Harrogate Electro-Hydropathic Company, Limited.—A letter addressed to the Registrar of Joint Stock Companies, and filed with the documents of this company, states that in the spring of 1882 the bulk of the property of the company was sold, and that Mr. Charles Smith and Mr. Wm. Thompson Burns (who were largely interested in the company) by deed, dated 10th June, 1882, agreed to concur to take all necessary steps for dissolving the company, both parties undertaking to pay certain debts, and Mr. W. T. Burns also agreeing to deal with the remaining shareholders.

London and Provincial Electric Lighting and Power Generating Company, Limited.—An order of the High Court of Justice, Chancery Division, dated 3rd ult., was filed on the 17th inst., ordering the winding-up of the company, upon the petition of Mr. William Russell Crowe, of 30, Budge Row, chartered accountant, the said order also directing the payment of the costs of the petitioner from the assets of the company.

South African Brush Electric Light and Power Company, Limited.—The annual return of this company, made up to the 10th inst., was filed on the 12th inst. The nominal capital is £100,000, in £5 shares, the whole of which have been taken up, and £2 10s. per share called thereon. The calls paid amount to £49,114, leaving £886 unpaid, the paid-up capital thus showing an increase of £935 as compared with last year's return. Registered office: 5, Copthall Buildings.

PARTNERSHIP DISSOLVED.

Young, Frederick James, and Heaton, John Arthur Dakeyne, telephone, telegraph, and bell case manufacturers, of 11, Clerkenwell Green. Frederick James Young retires in favour of Richard James.

BILL OF SALE SATISFACTION.

Gülcher Electric Light and Power Company, Limited; registered office, Battersea Foundry, Battersea, to William Crookes. Bill of sale filed September 8th, 1883, for £5,000, &c.; satisfaction filed December 6th, 1883.

BILL OF SALE FILED.

Newing, Thomas Edward, 23, Elmar Road, West Green Road, Tottenham, telegraph clerk, to London and County Advance Company. Dated November 30th; filed December 5th. £30.

DEBTOR'S PETITION FOR RELIEF.

Atmaram Sunderji Kertiker, of Mugbhat Lane, without the Fort, Bombay, clerk in the employ of the Eastern Electric Light and Power Company, Limited. Petition filed 2nd August.

MEETINGS OF CREDITORS.

Hawkes, George, of 9, Victoria Chambers, Westminster, and elsewhere, inventor and patentee of electric light apparatus. At the offices of Messrs. Lumley & Lumley, 37, Conduit Street, Bond Street, W., on the 31st December, 1883, at 3 p.m.

Markin, Arthur, 54, Milton Street, Nottingham, electrician at the office of B. H. Cockayne, 8, Fletcher Gate, Nottingham, on the 3rd January, 1884, at 4 p.m.

COUNTY COURT JUDGMENTS.

Holst, A., 2, St. Paul's Parade, Oakfield Place, Clifton, Bristol, electrician. November 3rd. £14 12s. 8d.

Binko, Mr., Crystal Palace, electro railway proprietor. October 29th. £16 3s. 6d.

PROCEEDINGS OF SOCIETIES.

The Society of Telegraph Engineers and Electricians.

AN ordinary general meeting of this society was held on Thursday, December 13th, Mr. WILLOUGHBY SMITH, president, in the chair.

The minutes of the last ordinary general meeting having been read and confirmed, and the list of new, and proposed new, members read, the Annual Report of the council of the society was read by the Secretary, as follows :—

During the past year the numerical strength of the society had been increased by the addition of 15 foreign members, 10 members, 123 associates, and 14 students —a total of 162. 30 new members were awaiting election. The losses through death had been heavy, amounting to 27, namely, 1 honorary member, 8 foreign members, 10 members, 7 associates, and 1 student; amongst these were General Sir Edward Sabine, Mr. C. V. Walker (past president), Mr. C. F. Varley (vice-president), A. Niaudet, L. Breguet, and Sir William Siemens (past president). The thanks of the society were due to the Institution of Civil Engineers for their continued courtesy in allowing the meetings of the society to be held in their lecture-hall. Amongst the papers of which special mention deserved to be made, was that of Professor Hughes on "Magnetism." The society's prize of £10 had been awarded to Mr. J. Munro for his paper on "New Telephone Transmitters." The "Paris Exhibition" and the "Fahie" prizes had not been awarded, as the council did not consider that the papers contributed were of sufficient merit to justify their doing so; but they commended the papers of Mr. Shoolbred on "Electric Lighting," and Mr. Moon's paper on "A Static Induction Telephone." During the course of the year the society had been incorporated as a limited liability company, which marked an epoch in its history. The wire gauge question had been considered by the society, and as the proposed gauge was considered objectionable, a deputation had waited on Mr. Cheyne with the result that the present standard had been adopted. Mr. Latimer Clark had been particularly energetic in the matter. The British section of the Electrical Exhibition at Vienna had been taken in hand by the society, and this had resulted in the display sent out being considerably increased. The British Commission, consisting of Sir W. Siemens, Sir F. Abel, and Lord Sudeley, had endorsed the energy of the council in the matter.

The finances of the society were in a flourishing condition; the sum of £165 10s. had been received for life compositions; this, together with previous amounts, brought the total amount invested to £876 5s.

The fourth report of the Librarian was then read as follows :—During the past three years the number of visitors to the library had been as follows: 1881, members 180, non-members 158; 1882, members 313, non-members 248; 1883, members 403, non-members 240. A great many written enquiries had been received for information; this, as a rule, had been afforded with but little trouble. The electrical patent specifications, which were supplied gratis by the Commissioners of Patents, were kept up to date. The number taken out during the last five years were as follows :—1879, 300; 1880, 260; 1881, 458; 1882, 845; 1883, 620. In two years 11,644 patents had been taken out, and of these 12·6 per cent. were electrical. Large additions have been made to the library, both by presentation and purchase. In 1881, 156 works had been presented and 52 purchased; in 1882, 151 presented and 94 purchased; and in 1883, 204 presented and 284 purchased. Although great thanks were due to those who had sent presentation copies, it was much to be regretted that this practice was not more generally followed, as the money thus saved could have been expended in making further additions. It had been suggested that books on chemistry and physics should be included in the library, but at present the funds of the society would not admit of this being done. A large number of scientific periodicals were amongst the weekly additions. A catalogue was being drawn up, showing all the books in which earth currents were referred to.

The PRESIDENT having moved that the report be adopted, the usual votes of thanks to the honorary secretaries, the Institution of Civil Engineers, the honorary solicitors, &c., were passed. The result of the ballot for the council for the coming year was then announced as follows: *President*—Professor W. G. Adams, F.R.S. *Past Presidents*—Sir William Siemens, D.C.L., LL.D., F.R.S. (deceased); Frank Ives Scudamore, C.B.; Sir William Thomson, LL.D., F.R.S.; Latimer Clark, M. Inst. C.E.; C. V. Walker, F.R.S. (deceased); Sir Frederick Abel, C.B., F.R.S.; Colonel J. U. Bateman-Champain, R.E.; W. H. Preece, F.R.S., M. Inst. C.E.; Professor G. C. Foster, F.R.S.; Lieut.-Colonel C. E. Webber, R.E., C.B.; Willoughby Smith. *Vice-Presidents*—C. E. Spagnoletti, M. Inst. C.E.; Professor D. E. Hughes, F.R.S.; Sir Charles Bright, M. Inst. C.E.; Edward Graves. *Council, Members*—William T. Ansell; Professor W. E. Ayrton, F.R.S.; E. B. Bright; T. Russell Crampton, M. Inst. C.E.; M. C. Forde, M. Inst. C.E.; Dr. J. H. Hopkinson, M.A., F.R.S.; Alexander Siemens; Augustus Stroh; R. E. Crompton; William Crookes, F.R.S.; J. E. H. Gordon, B.A.; Lieut.-Colonel E. D. Malcolm, R.E., C.B. *Associate Members of Council*—Capt. G. W. Addison, R.E.; George Chatterton, M.A., Assoc. M. Inst. C.E.; Martin F. Roberts, F.C.S. *Hon. Treasurer*—Edward Graves. *Hon. Secretary*—Colonel Frank Bolton. *Auditors*—J. Wagstaff Blundell (Wagstaff Blundell, Biggs & Co., chartered accountants), 12,

Delahay Street, Westminster, S.W.; Frederick C. Danvers, India Office, S.W. *Hon. Solicitors*—Messrs. Wilson, Bristows & Carpmael, 1, Copthall Buildings, E.C.

A paper was then read by Mr. J. E. H. GORDON, B.A., on "An Instrument for Measuring the Strength of a Magnetic Field." In the construction of dynamo machines it was advantageous to be able to measure the strength of the magnetic field of the magnets, &c. The instrument invented for this purpose was based on that employed by Verdet in his investigations on the effect of magnetism on polarised light; it consisted of a small coil of wire, which could be allowed to turn suddenly through a quarter of a revolution by means of a spring. The current induced by the movement of the coil produced a throw on a Thomson galvanometer, and this throw would be in direct proportion to the strength of the magnetic field through which the coil turned. The results obtained were not, of course, absolute ones, but they afforded useful comparative results. The coil was about one inch in diameter, and when it was pulled round by means of a small lever the connection between it and its terminals was broken, but immediately the lever was released, so that the coil could spring round a quarter of a revolution under the influence of a spring, the connection was immediately made again. The coil was mounted in a small frame, which could be slid up and down on a graduated rod, so that its position in any magnetic field could be adjusted; its position in the horizontal plane could also be adjusted by means of a graduated scale on the stand on which the vertical rod was fixed.

A second paper was then read by Mr. Gordon on "A Method of Calculating the Total Horse-Power Expended in a Network of Conductors (such, for instance, as a system of street mains)."

In all systems of electric lighting it is important to know what proportion of the electricity generated is utilised in the lamps, and what proportion is wasted in heating the conductor. When we have a rule for determining this we can properly apportion the diameter of each conductor to the current it has to carry, and to the distance to which it has to carry it; so that, on the one hand, we may not, by making the conductor too small, expend too great a quantity of coal in forcing the current through it, nor, on the other hand, by making it too large, so increase our capital expenditure on copper that the interest on it is too large a proportion of the annual rental which we can charge for the electricity used in the lamps. When the *same current* passes through two resistances, such, for instance, as a wire and the lamps fed by it, the horse-powers expended in the two resistances respectively is simply proportional to the resistances. For, if r and r' are the two resistances, the horse-powers expended in them by the *same current* (C) are respectively,

$$\text{H.P.} = \frac{C^2 r}{746},$$

and

$$\text{H.P.}' = \frac{C^2 r'}{746}$$

and their ratios are

$$\frac{\text{H.P.}}{\text{H.P.}'} = \frac{\frac{C^2 r}{746}}{\frac{C^2 r'}{746}} = \frac{r}{r'} \quad \ldots \quad \ldots \quad (1)$$

When, as in arc-lighting, the lamps are all placed in series, the determination of the relative horse-powers is very simple, for the wire is of uniform section throughout, and its total resistance is its resistance per yard multiplied by its length in yards. The resistance of each lamp is known, and the total lamp resistance is the sum of these resistances. *Example*:—Sixteen arc lamps, each of 2·1 ohms resistance, are placed on a circuit of 450 yards long, consisting of a wire having a resistance of ·006 ohm per yard. What proportion of the horse-power is used and wasted respectively?

The lamp resistance $r = 16 \times 2{\cdot}1 = 33{\cdot}6$ ohms.
The wire resistance $r' = 450 \times {\cdot}006 = 2{\cdot}7$ ohms.
The ratio

$$\frac{\text{H.P.}'}{\text{H.P.}} = \frac{r'}{r} = \frac{2{\cdot}7}{33{\cdot}6} = {\cdot}08,$$

or 8 per cent. Care must be taken not to confuse the ratio of horse-power wasted to horse-power used with the ratio of horse-power wasted to total horse-power. The latter is the ratio of wasted horse-power to the sum of the wasted and used horse-powers, or

$$\frac{\text{H.P.}'}{\text{H.P.} + \text{H.P.}'} \quad \ldots \quad \ldots \quad \ldots \quad (2)$$

This, in the case when the current is the same throughout the circuit, still depends only the resistances and is given by the formula

$$\frac{\text{H.P.}'}{\text{H.P.} + \text{H.P.}'} = \frac{r'}{r + r'} \quad \ldots \quad \ldots \quad (3)$$

With a circuit as given in the previous example, the ratio of the horse-power wasted to the total horse-power would be

$$\frac{2{\cdot}7}{33{\cdot}6 + 2{\cdot}7} = {\cdot}074, \text{ or } 7{\cdot}4 \text{ per cent.}$$

With one group of incandescent lamps, either in quantity, series, or of any combination of the two placed at the end of a pair of leads, as in fig. 1, the

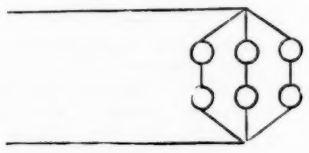


FIG. 1.

problem of the determination of the relative horse-powers wasted and used is equally simple; for the wire being of uniform section, we know its resistance, and the resistance (R) of the group of lamps is given by the usual formula

$$R = \frac{r\,s}{q},$$

where r is the resistance of one lamp, s the number of lamps in series in each branch, and q the number of branches arranged in quantity. The current in every part of the leads being the same as the current in the group of lamps, the relative horse-powers are still proportional to the relative resistances. In all these problems the longer the conductor is, the thicker it must be; for if a given conductor wastes a certain horse-power, and we wish to double its length, *i.e.*, to put the lamps twice as far from the machine, without increasing the waste, we must also double its sectional area, so as to keep the resistance constant. In practical incandescent lighting, however, the lamps are distributed at intervals along the pair of conductors, as in fig. 2, and the problem at once becomes much more

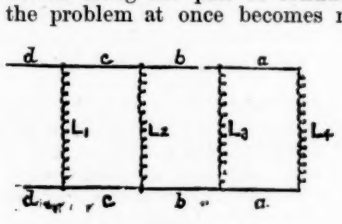


FIG. 2.

complex, because different parts of the conductors are carrying currents of different strengths, and the simple formula (1) is no longer applicable. For in fig. 2 if the branches, L_1, L_2, &c., are considered as single lamps, then the portion

a	of the conductor carries the current of	1	lamp,
b	"	"	2 lamps,
c	"	"	3 "
d	"	"	4 "

(To be continued.)

CITY NOTES, REPORTS, MEETINGS, &c.

Eastern Electric Light and Power Company, Limited.

The second ordinary general meeting of this company was held at the City Terminus Hotel, Cannon Street, on Friday, the 14th inst., Mr. E. Noel, M.P., chairman of directors, presiding.

Mr. Walter Jackson, secretary, read the notice convening the meeting, and the minutes of the previous ordinary general meeting.

The Chairman then said: I have to move that the report and the balance-sheet be accepted, and in doing so I don't know that I need detain you very long, for I think the report itself explains the present position of the company. Of course, I should be happy to answer any question if any shareholder thinks that what we have here is not sufficiently explicit. There are just one or two points in the accounts I should like to point out, the first of which is, the land and buildings in Bombay are put down at £8,300: the information we have received from India is that they are worth that amount, but whether they are or not the home Board can have no opinion about. As regards the home expenditure, in London we have an item of £5,948, which includes directors' fees; but I may say that the directors have received no fees; they are put down here because they are legally due, but they have not been received for nearly eighteen months, and therefore that amount is not nearly so large. Then, as regards machinery and stores, there is an item of £1,627 for London, which some may think rather large. That sum is made up really of what we have paid for the Swan lamps, a number of which have been sent out to Bombay; and two items, one of £200 in advance for engines ordered by telegraph for India, and another of £200 for lamp-posts, which were also ordered, but the consignment was not required when the work at Bombay was reduced. We had a capital of £80,000 to spend in Bombay under the authority of the Indian Executive; there has been an amount of something like £15,000 also spent in Malta, Egypt and Penang. In Egypt we had advices which led us to suppose there would have been very profitable business there, and in all probability there would have been, but the war broke out and destroyed any chances we may have had there. As regards Malta, we had the installation put up successfully, and if the Government had given what we were led to expect, to the amount of 16 lamps, it would have been self-supporting; 24 lamps would have returned us a fair percentage on our capital. With regard to the progress of the company, which, as the report shows, is an eminently unfortunate one, I think we may say the chief cause—there are numberless other causes—which produced the present condition of the company was, as we have told you in the report, the determination of the Indian Government to prevent overhead cables, and no underground system having yet been perfected that is suitable for a climate like that of India, the executive in India found almost insuperable difficulties in carrying out installations, and installation after installation, which might have been successful, failed, owing to that cause. Some might say, "As that was some time ago, why was such a large amount of business conducted there after the Government had determined on that course?" and the answer is very simple, at least as far as your Board are concerned. I hold in my hand the abstracts of all the correspondence, and we had no choice as to the course we were to pursue, inasmuch as we had, notwithstanding this difficulty, such distinct orders from India as to what was required, that the orders we were getting were all likely to pay us from ten to twenty, or even more, per cent. per annum; and therefore the home Board had simply no choice in the matter but to send out those goods that were demanded. When engines and dynamos were ordered by telegraph it was quite evident it was for some purpose clear and definite in the minds of the Indian executive, and the home Board could not refuse. I should very much like, myself, and I think the shareholders would like—and it is for them to decide—that a committee of investigation should be appointed to look into the whole question of how this company has been conducted. The directors have nothing to conceal. I can only say I shall be most happy to do my utmost to give such a committee every opportunity of investigating all that has been done, and I should rest perfectly content with the report that such a committee of unbiased shareholders would make. Looking back, I believe that we could have done nothing else than what we did do. There may have been initial mistakes; for instance, I think it was an initial mistake when we gave such a large amount for the patents; but that was at a time when electrical lighting was believed in far differently to what it is now. But from the time we received advices from India as to the good work being done, the lighting contracts we had obtained, and the great prospects that lay before us, I say the Board at home had simply no choice whatever but to fulfil orders as they received them from India. I beg to move that the report of the directors and the statement of accounts to the 30th of September last, submitted to this meeting, be received and adopted; and if that is passed, I shall be very happy to move or second, if it is wished by the shareholders, that a committee of investigation be appointed to look into the whole of the correspondence and into the whole manner in which the company has been conducted. I should like such a committee to be appointed for the sake of the directors and also for the sake of the shareholders. Of course, if the shareholders do not wish it, I cannot enforce it, but I think it would be to the interest of every one that it should be done.

Mr. James Pender seconded the adoption of the report.

Mr. Bartley said he should like to know why it was the directors did not ascertain, before remitting such large quantities of goods, what the Indian Government intended to do with regard to the overhead wires. He gathered that they had something like £56,000 worth of goods at Bombay useless; and it appeared to him, if nothing could be done with the underground wire system, it would be best to have those goods back and dispose of them as best they could.

The Chairman: We have no power.

Mr. Bedford expressed surprise that the chairman had not proposed something or made some definite reference to the future of the company. If anybody had anything to say about the future of the company it should be the directors; they had had the shareholders' money, £80,000, out of which they had seen fit to spend £75,000 in machinery which practically appeared to be useless. He took exception to the assertion of the chairman that it was a mistake to pay such a large amount for the patents: the Eastern Electric Lighting Company, which, although he held shares in several, he had considered to be the best, paid a very small amount compared with others that followed them.

The Chairman said they could not find out what the Indian Government intended to do, except through their executive officers in India. We had to follow the advices of those who were on the spot, and who could know exactly what was being done. Rather strong remarks had been made, and he did not wonder that they had been; he held shares in the company and was in perfect sympathy with the shareholders. It had been said that they ought to have looked into the orders to see that they were *bona fide*. Of course they did so; they were directors and did their duty. He then read extracts from several letters from Major Strutt, the managing director, who was at that time in India, some of which read as follows: "You need not fear our not being able to dispose of all machines you may send me;" "I cannot too strongly urge on your completing my orders by wire without delay;" "You must send out proper material; driblets of cables, insulating material, &c., only make us a laughing-stock;" and there were others equally pressing. When the responsible person spoke like that, was it not the bounden duty of the Board to send the goods ordered? The Municipality of Bombay granted the company the especial right to run overhead wires before they embarked in that large outlay; and then the Supreme Government interfered and prevented them from doing it. As to the future of the company, he did not know what propositions there were to make. The directors had been doing all they could to find out how the business that had been established in India could possibly be carried on. They had no means themselves, and they had been striving to find out whether means could not be found. It was quite evident shareholders of the company would not give them more money, and they had been looking about in every possible way, but they could not, in the present state of electrical lighting, see any body of persons ready to take up the business. It must be recollected that since they began operations a great change had taken place in the public mind with regard to electrical lighting. Some time ago there was a great belief in it, and he still held the belief that it would yet be established, although the difficulties to be overcome by scientific men were very great. When a proper underground system was discovered, they would be able to carry out really good installations, and would have a satisfactory electric light; but till that was done, he did not know how they were to meet the difficulties. They could not be pioneers—they had neither the means nor the opportunities; and therefore they could not invent what others had not yet invented. In the meanwhile, all he could say was, that if the shareholders liked to wind up, that was one way; if they liked, on the contrary, to stay on as long as they could in the hope that they might find somebody who would undertake the work they had begun, and in many cases well begun, in India, the Board would continue to aid them to the utmost of their power. He believed no electric lighting company in the world had done so much, or such good lighting, as the Eastern Electric Lighting Company, and none had worked under such difficulties: and if it had not been for the action of the Government in India, he thought they would not have been in the position they were. It had caused almost all the failures of the lighting in Bombay, and prevented the formation of a company which would have relieved them of all difficulties in connection with their work there, and given them capital with which to make a fresh start in Calcutta, with every chance of success.

Mr. Bartley asked upon what grounds the Supreme Government overruled the Bombay Municipality?

The Chairman replied, that he believed it was because of the exaggerated ideas they had of the dangers of overhead wires. The ignorance displayed by the Supreme Government was something extraordinary. They published a long statement of their reasons, two-thirds of which electricians in this country knew to be absurd. At the same time he (the Chairman) thought that, although the dangers and difficulties of overhead wires were not so great in India as in this country, an underground system would be vastly better.

Mr. Bedford thought it was by incandescent lamps and accumulators that this company worked, and that the system did not require wires. What money, he asked, was paid to the Oriental Storage Company for accumulators?

The Chairman replied that nothing was paid to the company mentioned, because the accumulators, from one cause and another,

did not work—chiefly in consequence of the failure of the underground wires. The idea was a fallacious one that no wires were needed for the accumulators.

The motion for the adoption of the report was then put and carried.

Messrs. Deloitte, Dever, Griffiths & Co., having been re-elected auditors for the ensuing year,

Major C. H. Strutt, managing director, rose to give an explanation of the occurrences in India. He said, Gentlemen: When I went out to India two years ago, I was under the impression that we were to form small local companies there, and not carry on any great works ourselves; but on my arrival, I found it was impossible to form any companies unless we exhibited what we could do and showed what our patents were worth. With this object we commenced operations. We had great difficulty in getting experienced electricians, but, at length, after several attempts we succeeded in giving very good installations indeed. The first supply gave us £600 a year. We then undertook the lighting of the Princes' Dock, a large affair, and it was entirely by our assistance that the dispatch of troops on one occasion was conducted with such great expedition. Unfortunately, the Government issued those orders with regard to overhead wires, which completely paralysed our operations. A shareholder asked just now, why we did not make enquiries whether the Government were going to stop the overhead lines. Considering that all the telegraph and telephone wires were overhead, we had no reason to expect interference by anybody; we looked at the Bombay Municipality as supreme in their own district, as they did themselves. They gave us permission to erect the lines, and were equally astonished with us when the Supreme Government issued those orders. I had a long correspondence with the Supreme Government, endeavouring to get the orders cancelled, but without effect. Our business extended so rapidly that it became necessary to erect buildings and purchase land. We supplied 100 arc lamps, which brought us £4,000 a year; and incandescent orders were unlimited—in fact, are now, and if we could carry them out, the income upon them would exceed £20,000 a year. The home Board sent me out a very good electrician, who introduced an underground system, and we laid our cables so as to carry out the orders of the Government, as we thought, with great success; but the high tension lines, during the heavy rains from June to December, would not carry the strong current our cables were required to convey, and the latter were burnt up; this, of course, brought great discredit upon the company. One or two installations which we took up the country, in the cities of Beyrout and Surat, were very successful; but a heavy flood arose, all the works were under water—in fact, the whole city was under water—and, of course, our work was stopped there. These installations covered their expenses, and we anticipated that the municipalities would eventually buy them from us; and probably they will buy them if we can carry on our work. With regard to the remarks made respecting the accumulators, after waiting some months for them, they arrived; our own electricians were not experienced in the use of them, and the first lot was damaged in transit. Eventually, however, the parent company assisted us, and we managed to carry on one or two good installations. At this time, however, what with delays and the orders of the Government, our finances ran short. I am perfectly willing to take upon myself the whole responsibility for our work in India, and of all the machinery, &c., that was ordered. We ought not to forego what was suggested by the chairman with respect to the appointment of a committee of investigation. As far as I am concerned, I am perfectly satisfied that the company can be made to pay. We have some very excellent contracts in Bombay which pay their own expenses, and by reduction of the staff and careful economy in carrying on the work, with the assistance of the shareholders, I have no doubt the company can be restored. I do not take the gloomy view of the position some of the directors appear to do. I am a large shareholder, and am perfectly willing to give you the benefit of my past experience, and our chief electrician, who will be home in a few days, I am sure will do so also. I am perfectly certain we can pull the company through its difficulties. The lighting in India is unlimited. There are only two gas companies there—one in Bombay, the other in Calcutta, and the one at the former place has spent £250,000 in works. They get from the municipalities about £22,000 per annum for street lighting, and by private lighting about £25,000 per annum, and out of this they only pay 7 per cent. We have a license with the Bombay municipality, which amounts almost to a monopoly, a license for ten years to open streets and run our lines underground, at a nominal rental of £10 per year after the second year of lighting; they repair the roads after us, and assist us in every way possible. When the gas contract expires, in three or four years' time, from what the commissioner informed me, I have no doubt we shall have the entire lighting of the streets of Bombay, if we only hold on, and this would produce a handsome revenue. I feel perfectly certain no license would be given to any other company as long as we are able to carry on our work. The price of gas in Bombay is 10s. per thousand cubic feet, and therefore there is no difficulty whatever in competing with the gas companies. Our business rests on incandescent lighting, and, as far as orders go, they are unlimited; and the Indian and Oriental Storage Company have acquired a new accumulator which will assist us very materially. There is a very large business to be done with the native states; they were all very much delighted with the light, but the orders of the Supreme Government created such a scare throughout the country with regard to electric lighting, that for a short period there was a lull in the demand, and all the orders I was negotiating for were suddenly withdrawn; every native in the country suddenly gave up all idea of electric lighting in consequence of those ridiculous orders. In conclusion, I propose that a committee of investigation be appointed, and, if their report is satisfactory, that they bring the same before the shareholders with certain propositions with regard to the future working of the company. We shall certainly have to issue debentures, and I feel the majority of the large shareholders have no objection to an issue of 7 per cent. on a mortgage on the whole of our properties. The property in India, the buildings and land, is quite as valuable, even if not more so, as when we bought it, and we have plant and machinery for carrying on an extensive business. We could not undertake any large works but could conduct merely a selling business, and, if possible, form small subsidiary companies for taking up our patents.

Mr. Bull asked what other electric lighting companies there were in India.

Major Strutt said the Jablochkoff Company had been established at Bombay for some years, and had brought considerable discredit on electric lighting, but had still done a large business, having handsome returns upon the supply of their candles alone. He attributed some portion of the failure of the proposed Bombay company to the undermining of the minds of the native directors by a gentleman connected with that company.

No one rising to second the motion for a committee of investigation,

A Shareholder moved a vote of thanks to the chairman for the zeal he had shown in the interests of the company, and said he trusted the time would come when he would be able to meet them with something more tangible and something more satisfactory to himself and to the shareholders.

This was seconded, but before it was put,

Mr. Bull asked what was to be the result of the meeting. The committee suggested had not been appointed, and they appeared to have come to no decision.

The Chairman said the directors would continue to do all in their power to evolve the company from its difficulties, and as long as there was the faintest hope of its going on they would not resign, although his personal inclinations would lead him to do so that day. Still he did not feel that it would be right, and even should there be no hope of continuing, before resigning his position he would promise to call them together and submit a statement of affairs.

The chairman's remarks were received with applause, and, the vote of thanks being understood to be carried, the meeting terminated.

The Metropolitan (Brush) Electric Light and Power Company, Limited.

Sir Michael Kennedy, K.C.S.I., Chairman of the Board, presided at the first annual meeting of the shareholders, held at the Cannon Street Hotel, on Monday morning. There was a large attendance of shareholders.

The Secretary, Mr. Robert Wilson, having read the notice convening the meeting,

A Shareholder asked if the chairman was aware whether there was any person present other than shareholders and the press?

The Chairman replied that he did not think there was any one except Mr. Sellon, of the Brush Corporation, and he supposed the shareholders would not object to him. (No.)

The Chairman: Will you take the report as read? (Assent.) Well, gentlemen, we have in our report given you a sketch of our past proceedings, and of our present position. And we have done so at some length, in order that you might have an opportunity of forming an opinion upon our general position, before you met us here this day. I do not now propose to enter into any long discussion as to our past efforts, as we must admit them to be failures. We have been traversing experimental ground, which all electric lighting companies have had to pass through, and like others, we have had to obtain our experience at a very heavy cost. We began too soon; we were in too much of a hurry; the ground was not ready for us. It is very easy to be wise after the event. We were all too sanguine when these electric lighting companies were started in the spring of last year. But we are wiser now. What, as business men, we have to do is to profit by the lessons we have learned, and to endeavour to shape a safe course for the future. We have to consider whether there is really anything in electricity as applied to industrial purposes, whether the movement is a sound one, and if it be, what our position is for taking advantage of it. If there is nothing in electricity, if there is nothing in the movement, if it is *not* sound, then, gentlemen, I say the sooner we are out of it the better. (Hear, hear.) But if the concurrent opinion of thinking men in all countries, and the fact of a great and growing demand is any guide, then, gentlemen, the movement *is* a sound one, and we should be unwise to throw away the great advantages which we have obtained for developing this new industry in our metropolitan district and making it a great success, which there is every reason to believe it may become. The main difficulties which met us at the outset were want of legal powers and a good system of incandescent lighting on a large scale and aided by a skilled and reliable agency for carrying out the work. These difficulties have now been overcome. In our present twenty-three provisional orders we have an unexampled field of operations. Dynamos for incandescent light-

ing on a large scale and from central stations, and secondary batteries for storage have now been perfected and are available, and the mode of working and carrying out the electric light installation is now well understood. You must not suppose, gentlemen, that our efforts have so far failed for want of demand. On the contrary, from the very first, the demand for incandescent lighting was very great, as the books of this company will show. But we were unable to get to our work; we had no power for placing our mains below ground, and you are all aware we met insuperable difficulties in maintaining and placing our overhead wires. The most important point now before us is our agreement with the Brush Corporation. Working under the Electric Light Act, and having in view the daily increase of electrical knowledge, we find that being tied to one system, no matter how good that system might be at the time, it would be fatal to us. It became necessary that we should obtain freedom and that we have obtained under the agreement with the Brush Corporation, the heads of which the solicitor will now read to you.

The Solicitor then read as requested. The agreement set forth, amongst other things, that the Metropolitan Brush Company be free from the restrictive clauses in the agreement; and that the Brush Company was to be free to sell and do business in the district of the Metropolitan Company by paying 10 per cent. in respect of machines sold by them in the district, &c.

The Chairman: You see, gentlemen, under this agreement we are free to use any system we please, and the Brush Corporation cannot do business in our district without paying us liberal royalties upon any such business. Further, that we obtain an additional discount over and above that originally accorded to us in our license for all Brush and Lane-Fox machines, and a discount of 20 per cent. upon all other machines supplied to us by the Brush Corporation, over which we had previously no claim. I cannot but think that that agreement will be a very good settlement, so far as a modification of the terms of the license are concerned; and your directors, acting under the powers they possess under the Articles of Association, would at once have closed negociations and clenched the matter had it not been for the clause which relates to the abandonment of claims. At one time we thought we had a very serious claim against the Brush Corporation in regard to the formation of this company. We placed the matter in the hands of wholly independent solicitors—the eminent firm of Linklater & Co.—who, under our instructions, prepared a case for the opinion of counsel setting forth, as fully and ably as I believe it was possible to do, all the points which bore upon the formation of the company, which left nothing unsaid which could be said which would guide counsel in forming an opinion towards those who were connected with the formation of this company. A case was submitted to Mr. Romer, Q.C., with whom your directors had a long interview. It turned out that no sufficient cause had been shown to enable him to say that the company is entitled to succeed in any action against any other company. The opinion was based upon the conclusion that he had arrived at, that the prospectus did not contain any material misrepresentation of facts. This result was hardly what we expected, so we decided to take a still further and more eminent opinion. Messrs. Linklater advised us to take this step, because they did not agree with Mr. Romer's. So we took the opinion of the Solicitor-General; and Messrs. Linklater thought if that opinion agreed with Mr. Romer's, that would settle the question once for all. The same case was presented, and the Solicitor-General was of opinion that if any proceedings could be taken, it could only be against the City and Suburban Company; but as that company has been dissolved, that remedy is out of the question. As to claims against promoters, the Solicitor-General held that promoters might be held liable, if they got any secret benefits, to the extent of such benefits; but he did not see any such profits appearing on the face of the prospectus. The Solicitor-General advised only on the dry point of law. We were then in this position: if we did not obtain a material modification of our license, we could not do our business, or properly utilize our valuable Provisional Orders. If we went to law, any *immediate* modification of our license was out of the question. In the face of the opinions we had received, it would have been madness to have embarked on a course of litigation which would have paralyzed us in the present and offered no prospect of the future. Acting as common-sense business men might be expected to act in their own private affairs, we determined to push our business, and to let the law alone. We trust you will endorse that policy, and if you do not do that, I say there is nothing for it but to sacrifice all the advantages we have obtained and to wind up this company. (Hear, hear.) As to the utilization of our Provisional Orders, we have told you we intend to proceed with great caution. We have been twitted with pusilanimity for not having at once plunged into the Holborn work, and thus committed you to an enterprise which it would be better we left alone, unless you endorse our policy to-day. We think we should be credited for having resisted rash counsels. In Holborn we have made a house-to-house canvass with very encouraging results. We have a very carefully prepared and tested estimate for 3,000 incandescent and 50 arc lamps, which amounts to £14,400; and an equally carefully prepared estimate, which, taking the price of gas as the basis, will leave a return of 8½ per cent. on that amount. We have put the case against ourselves as much as we could, because, I think, in assuming the price of gas we have assumed something we shall not be driven to accept. We cannot but think that for our better article we shall get a better price. If we take as the basis of our estimate 25 per cent. above the price of gas, then the return of our Holborn installation will amount to over 16 per cent., and this, of course, will be better as the installation increases above the number of lamps I have mentioned to you. Holborn we propose to make our test experimental case, and if it succeeds (cries of "If!"), as we have every reason to think it will, it will lead in several ways to the judicious utilization of our several Provisional Orders. The carrying out of these Provisional Orders will necessitate an appropriation of capital to the extent of £15,000, £1,500 of which is to be paid up to the Board of Trade, and the balance in the course of six weeks after demand. When the whole of the £15,000 worth of work has been executed, the whole liability disappears. The Orders of this company, differing as they do from the general orders, are, in short, in the nature of permissive powers. In the case of the winding up of a company orders lapse. There is just one important matter to be arranged with the Board of Trade; the 11th of February is the limit of time for appropriating these powers. But if this company by that time shows prosperity as substantial as at present, we may look for an extension of time on application. This mode of procedure will be attended to; another advantage—the interest in our proceedings will increase. During the next few months such advantageous proposals may be made to this company in regard to other orders as to prevent the necessity for this company finding any further capital. The policy of carrying out the Holborn work in the best possible manner, and securing some extension of time in other orders, is a policy which the directors think likely to result in the greatest advantage to the shareholders of this company. For practically carrying out our work, we have entered into an agreement with the Hammond Company whereby all the metropolitan electric lighting work of both companies will be carried out by the Hammond Company at the prime cost, and at their own risk as regards possible loss, each company having an equal share in the profits. I think this is a favourable arrangement for us. We get the use of the Hammond Company's factories, but we are in no way bound to their particular system. We also obtain the use of the skilled and trained staff, and are spared the expense of creating and maintaining such a staff for ourselves, while we share equally with the Hammond Company in all outside contracts, and incur no risk in respect to those contracts. We get our own work done without risk at a small contractor's profit. You will note that either party is entitled to withdraw unless we call capital in a certain time, and we shall certainly not do this unless we see our way to profitably employing such capital. This agreement means also the abandonment of a lawsuit which we now have against the Hammond Company, which lawsuit, if pressed home, would not compensate for the money expended in litigation. This has been called a formidable action, but it only involves the amount of the salary of our late manager for a period of less than one year. I may now briefly refer to a somewhat disagreeable subject—the position which our late manager, Mr. Pollock, has thought fit to assume towards us. I give Mr. Pollock credit for a sincere desire for the good of this company—(hear, hear)—and for great zeal when in the company's service. (Hear, hear.) But, gentlemen, zeal which is untempered with discretion, which is accompanied with a rash, hasty, and litigious spirit, is a dangerous quality. Such a spirit Mr. Pollock seems to possess. ("Question.") I hold in my hand a circular which Mr Pollock has not thought it wrong to send to the shareholders of this company. You must not suppose that because Mr. Pollock's communications were unanswered that therefore they were unanswerable. The fact is, that your Board had something else to do; they wished to get on with the company's business, and not to get into a long wordy war with a gentleman of lively imagination and facile pen. As to myself, gentlemen, I may say that certain statements made by Mr. Pollock as regards what passed between him and myself, are founded on a misapprehension on Mr. Pollock's part of what really *did* pass. I must repudiate entirely the complexion he has put upon them. My recollection of what did take place is borne out by a gentleman who was present. Your board consists of gentlemen of ripe experience and great business qualifications. ("Question" and laughter.) The stake they hold in the company is very large—nearly $\frac{1}{12}$th of the whole subscribed capital—("What did you pay for the shares?" and laughter)—and they were unanimous in condemning Mr. Pollock's attempts to force an unwise policy upon them in his action before and subsequent to his dismissal. The directors cannot doubt, gentlemen, that you will take the same view as they do of the matter; a view which, personally, I feel constrained to take with a great deal of pain, because, as you may gather from Mr. Pollock's remarks, I have a feeling of friendship towards him, and even now I speak more in sorrow than in anger, for I respect Mr. Pollock's motives, though I cannot but condemn his action. You are aware that a number of shareholders have issued circulars asking for proxies to endeavour to upset the policy of your directors. We have communicated with these gentlemen, and we find they are not for destruction, but they are anxious, as we are, for the success of this company's operations. This being the case, we shall be glad to meet them in any way we possibly can, and to accept any proposal they may make, if put to us in any shape that we can be reasonably expected to agree to. Our interests are all identical; your directors have nothing to conceal or suppress; we are ready to give any information it is in our power to give. The board, however, will not agree to any measure which will have the effect of stopping or retarding the acceptance of the report this day, and they deprecate any difficulties arising upon the point, as likely to be injurious to the company, which wants just now all the discretion,

strength, and zeal to deal with the important matters before us. I now move that the report and accounts as submitted be and the same are hereby received and adopted. (Cries of "No, no," and other expressions of dissent.)

Mr. Borrer (a new director) said he did not speak as a director who was a shareholder and had the reputation of a good judgment to maintain, but the reputation of a shareholder who bought his shares at a high price in order to have a voice in the working of the board. He only joined the board last August, and was in no wise inclined to defend anything which transpired prior to that date. He was sure that those of the "opposition," if he might term them such, were anxious, as the board were, that the best might be made of the opportunities before the company. He thought it was also perfectly reasonable that those gentlemen should desire to know a great deal more about the past affairs of the company, and the management of the future, than they could at present. They wished to know whether, at the time certain stations were organised, the directors were justified in expecting that they would have brought about good results. They wished to know why certain orders were not carried out, and if 23 Provisional Orders could not be obtained for a far less sum than they had cost; they wanted to see, too, whether things generally from the beginning had been managed with good faith, or whether they should ask any of the board to retire. These enquiries seemed natural enough in the face of the mysteries which had surrounded electric lighting companies generally. The directors were willing to give the desired information, and were also willing that a small committee should be appointed to examine the books, and if not satisfied then to call a general meeting of the shareholders to consider the report which the committee might make. The report had been delayed, for in August it was not quite known whether the Provisional Orders would be granted. They had only just come in, and it was felt that there would be no programme to place before the meeting unless it could be shown what the orders were good for. The estimates formed of these took many a long sitting. It was found that they could not be carried out without some modification of our license. The legal opinions at this time came in, and they too, required attention. Then the negociations with the Brush Company were carried on. The agreement they had heard referred to was only got into shape at the end of last month, and the result of this and of the estimates obtained were thoroughly satisfactory, and enabled a clear and encouraging programme to be set before them. This could not sooner have been done, and the Board wished to confirm the agreement at once, which would be a settlement of an account of £5,000 against them, when they thought they ought to pay only £1,000. He took it as a matter of course that their commencing work with one small district first would commend itself to all. Holborn was a good district to start with, because the houses were all close together, and would be very advantageous, because they had already a station there, and the estimates had shown that a good result could be obtained. They had already proof that other people had come to the belief that the lighting of districts would be profitable, especially as capital came forward for the purpose. He thought the policy proposed by the board for the future was one full of hope; and he found since August that the board as now formed had truly endeavoured to do the best for the company. He should have been willing to go with the shareholders who had asked for certain information had not the board been willing to allow a committee, chosen by the shareholders, to examine the books. He warned the meeting that the Board of Trade would not allow time beyond February 11th if they found the company were squabbling; and they must allow nothing to hinder their carrying out of these Provisional Orders. He must say, in concluding, that Mr. Pollock had a hankering for going to law, but he (Mr. Borrer) did not like the idea of spending a lot of money in that manner. He thought Mr. Pollock's judgment was at fault, for no company could conduct business if its servants were allowed to attend meetings in opposition to the policy of the board. He seconded the motion for the adoption of the report and accounts.

Mr. Bell moved an amendment. He said he had been the holder of 400 original shares of the company, but he had only kept 100. He took the position he did, of opposition to the board, in the interest of his brother shareholders. His motion was, "That this meeting regards the report and accounts of the directors as most unsatisfactory, and urges that the same be not approved or adopted, and that a committee of shareholders be appointed to investigate the circumstances of the company, and the circumstances attending its promotion and formation, with full power to call for documents, books and papers, examine officers of the company, past and present, and that such committee report the result of their investigations and their recommendations, if any, as soon as practicable, and that they be empowered to employ electricians, accountants and solicitors, if necessary." He was willing that the directors might add to the committee. The circumstances attending the formation of the company had not been touched upon by the chairman or Mr. Borrer, which would have been more satisfactory. There were now only three original directors on the board. He should like to know what led to the retirement of Mr. Alderman Whitehead and others. They would like to know, too, the full particulars of the balance sheet, which the chairman had not touched upon. The "opposition" had not taken the steps they had, in the attitude of wreckers, and they would like to know if there really was anything in the Holborn contract, for the eel had been pretty well skinned, and the operation was not a pleasant one. Where had the £235,000 gone, and in whose hands was some of it now? He had a profound impression that they would yet have to make somebody disgorge. The legal expenses, too, were very great. Therefore they needed a committee of investigation, for time spent in that way would be well employed.

Mr. Poole rose to speak amid cries of "Ten shares." He explained that the 10 shares he held were bought simply with the view of giving him a voice there, not only on behalf of himself, but on behalf of Mr. De Roubaix, who resided in Antwerp, who could not conveniently get to their meetings, but who was an original holder of 2,000 shares, upon which he had actually paid £3 per share. The directors had issued a circular in which they did him the honour of mentioning his name, adding that he only held 10 shares.

The Chairman: Will you speak to the question? (and uproar.)

Mr. Poole said he was called a solicitor, but he always thought that profession was an honourable one. If the directors thought otherwise he could only conclude they were peculiarly unfortunate in their experience. (Laughter). There was an item on the asset side of the balance sheet of £235,000 paid for concessions. But according to the prospectus issued, inviting them to take shares, the whole amount paid to the Hammond and Brush Companies was set down at £170,000; so that there was a slight sum of £65,000 dropped in between. He wanted to know why the directors had called that asset £235,000, because it was clear that the full amount of purchase-money was £170,000; although it might be right as a matter of accountancy to state the real book value of this sum. Where did the £65,000 difference go to? What value had the company got for that? For what purpose was the City and Suburban Company floated and incorporated? He would tell them!—to enable the promoters to plunder the public. It was a dodge to avoid the decision of the law courts, which put promoters in the relation of trustees to the company. Thereupon this scheme was devised. The City and Suburban Company was floated on Saturday, May 13th, 1882, and on Monday, the 15th, this present company was brought into the world; their most unnatural parent or parents brought the second twin into life, in order that it might be plundered by its elder brother, and that plunder consisted of £65,000. Mr. Poole then read the names of the seven subscribers to the City and Suburban, who, he said, held one share each, and were all clerks. Not a single share had been allotted in the City and Suburban, and they might take it that, upon the records at Somerset House, these seven individuals were the sole owners of the City and Suburban Company. He would like to know whether those seven poor clerks received the £65,000. Mr. Poole then went on to say that he (Mr. Webb) might be able to tell them why the City and Suburban Company was started on the Saturday, and on the Monday this Metropolitan, being the butt to make the plunder. He thought he had made out a case for investigation, and asked that the reception of the report and accounts be delayed. They need not be frightened that the 11th of February was coming. Who was to blame that there was only now two months to that date? The accounts were made up to June 30th; why were not the shareholders called together in September, especially as they had 23 Provisional Orders, which might be, all of them, white elephants. The profit and loss account he noticed was not vouched for by the accountants; and the balance sheet was dated 17th September. If the directors should be absolved from all insinuations by the investigation, then they would be willing to let the company go on. But without that investigation, he was sure that shareholders would not be willing to pay another shilling.

Mr. Peebles (late vice-chairman of the company), said he had allowed his name to be used as one of a committee of investigation, because he felt, in the interest of the shareholders, that such an inquiry should be made. When he sent in his resignation he wished to get an investigation of the accounts, as he always thought there was some sort of underhand work. (Hear, hear.)

The Chairman rose to correct what he thought was an unintentional reflection on himself and his colleagues. Mr. Peebles' resignation was addressed to him as Chairman of the Board, and not one word was said in it about Mr. Peebles being unable to carry his wish for an examination of the accounts, and his ground for his resignation was on account of his state of health.

Mr. Peebles: I sent a letter offering to stay on the Board if an investigation were granted. (Cries of "Where is the letter?")

The Chairman: I have not got it here (and hisses).

Mr. Digby Seymour, Q.C., who represented a large shareholder besides himself, thought that the shareholders would consult their own interests if they followed the policy indicated by Mr. Borrer. When he heard a professional man like Mr. Webb assailed by another professional man—(uproar). He asked that justice should be done him. [The rest of Mr. Seymour's remarks were continually interrupted, but he managed by great persistency, to urge the meeting to accept the policy of caution, and to limit their efforts in the development of the Holborn work, taking care to procure outside capital for the work.] He ventured to believe that if the Holborn works were successful, the 23 provisional orders would be worth £10,000 to this company. (Cries of "time," and "Webb, Webb," and "Pollock, Pollock.")

Mr. Roberts (who was met with cries of "How many shares?"), said he held 25 shares, and thought the suggestion of Mr. Borrer a sound one, and he hoped they would pass a resolution that day so that they were not brought there again for the same purpose. He thought they should put on the committee the largest *original* stockholders, and not a clique of gentlemen who had combined to make the undertaking a miserable failure. He also urged that the report be allowed to pass.

Mr. J. Keatinge Pollock, late manager to the company, said it was with no pleasurable feelings that he rose to speak. He sought neither to ape the hero nor to pose before them as a martyr, but some statements had been made which he must refute. This being the very first occasion on which he had addressed a public meeting, and having to follow a succession of fluent speakers, including an eminent Queen's Counsel, he must ask their indulgence. It was alleged in the report, and he had contradicted it in his circular, that he had persisted in the course of urging litigation. Nothing whatever of the kind occurred. He urged that an opinion should be taken. Making a digression, he might say that he himself saw the letter of Mr. Peebles, which stated his desire to remain on the Board if the Board were willing to have these matters investigated. The answer to that letter was prepared by Mr. Webb at a board meeting for the express purpose of clenching Mr. Peebles' resignation, but it was only fair to say that the chairman (for whom he—Mr. Pollock—entertained the kindest feelings) was at the time also absent through ill-health. He had not formed any prejudgment of their case. He simply said that he knew that shareholders were agitating in the Law Courts; and many others who had spoken to him from time to time, said there was something in this matter which ought to be cleared up. They told him of matters which they would hear of by-and-bye, if they had this investigation. Eventually a resolution was passed for taking an opinion, but it was so passed as to allow Mr. Webb to prepare his own case. He (Mr. Pollock) urged the taking of an independent opinion. Sir Michael Kennedy, after counsel's opinion had been obtained, told him that Mr. Webb, whether on his own behalf, or on behalf of the City and Suburban, had offered a sum of money to settle this matter. As he now heard, counsel advised that they had a good threatening case, and he thought Mr. Webb should have been kept in the dark, instead of which he had had all information. He believed that two of the seven subscribers to the City and Suburban Company (which was alleged to be a bogus company), were actually infants. These provisional orders were *not* in jeopardy. He thought that they had sufficient money to go on with 15 of their orders; they should appropriate their uncalled capital and go ahead. He knew that a mistake was made in the promotion of the company, and it was considered well that certain names should be kept concealed. He had tried to keep down the lawyer's fees and prevent litigation. ("What is the amount?")

A Shareholder: £8,000.

Mr. Pollock, continuing, said he was asked by the Board, after he had attended the private meeting of a few shareholders, whether he considered his loyalty was first to the shareholders or first to the Board. He replied that his loyalty was first to the shareholders; and when he knew, amongst other things, that this meeting was fixed for a Monday, so that a number of shareholders could not be present, he felt it his duty to step out and if he did not they would not have heard a single word of the whole of this. (Cries of "Webb," and loud hisses.)

Mr. Webb rose, and said he should be very sorry to occupy any position in London after an experience of 25 years in his profession, to make him ashamed to meet any body of shareholders, and to state to them any public business in which he had been engaged. Least of all was he ashamed to meet them there to-day. Indeed he had been looking for the opportunity for some time past. (Laughter, and "oh, oh.") He thought a solicitor to a company occupied a responsible position—("You will find it out")—and nothing should induce him to waive from the strict line of rectitude which he laid down for himself. They would be glad to hear of his part in their transaction. ("How much money did you receive?") In the prospectus it was stated that the solicitors of this company were also the solicitors of the vendor company. The vendor company was the City and Suburban. Why was that formed?—for the reason that £25,000 had to be deposited in the Brush Company before the option to purchase this company could be secured. Therefore it was necessary for some individuals to find this £25,000, and that sum was found—("Who found it?") —and the company was formed. ("How much did you get out of it?") There was a perfectly clear and fair disclosure of all the facts, on the face of the prospectus, which described the amount of capital, and stated that the company would be dissolved directly the purchase was completed. (Cries of "bogus company.") All the directors of this company were, except Sir Michael, entire strangers to him when the company was floated. He (Mr. Webb) intimated to the Board that he was concerned for vendor company, and it would be more agreeable to him for the Board to appoint independent solicitors, who might complete the purchase on their behalf, and he would stand on one side. He acted in no way for them. ("All cut and dried; you knew all about it.") With regard to the proceedings in the matter of getting the provisional orders, he thought he had attained eminent success. (Laughter.) Those gentlemen who laughed could not appreciate what it meant to carry 23 provisional orders under a new Act of Parliament, and with practice all new; and he might say that he found Mr. Pollock of great assistance to him in the negociations with the vestries. With reference to the expenses, he had agreed with the Board that he should be paid £50 for all orders applied for and not obtained, and £100 for all applied for and obtained. If they thought of the amount of work entailed in carrying only one of them through, they would consider that a very fair amount of remuneration. The matters of this company had been put into the hands of independent solicitors in July last, and he was not ashamed of the manner in which he had acted in regard to the opinions of counsel or in other matters. They might be disappointed that they had no claim against the original holders. No solicitor, Mr. Brown, nor anybody else, could find a single flaw in this matter. ("You took good care of that.")

A Shareholder, who held 125 original shares, thought that what they wanted was to save the money they had put in and not pay any more. He did not know a single gentleman on the board except the chairman. He thought they should take these two points—let the committee be appointed, and no further call be made without the sanction of the shareholders.

Mr. Talbot, holder of 120 original shares, knew nothing of the affairs of the company. The whole matter could be sensibly and quietly met by having a committee such as would satisfy the board and the shareholders. He thought they had no right to put upon the committee gentlemen who held less than 200 shares or so. Do not let them have any 10 or 25 shareholders.

A Shareholder thought the report of the directors was not very creditable to them. If the directors had acted in a hostile manner towards the wishes of the shareholders, they should go to the wall.

Mr. Wm. Abbot thought a committee of investigation was generally incubated to get the shareholders on the board. He never knew a shareholder thus born to be a director worth anything. He warned them not to let that committee wreck the company just at the time when they were in the position to do something. He had found Mr. Pollock a gentleman of wide range of thought and of extraordinary energy, and he was glad Mr. Pollock did not desire to wreck the company, but he seemed to think that the only panacea for the ills of that company was to make Mr. Walter Webb a sort of financial Jonah, and throw him overboard. With the £150,000 assets they had a fair starting-point to galvanise life into those Provisional Orders, and he hoped the committee would keep that in view. He felt perfectly certain from what he knew of what was going on in the electric world, that those Provisional Orders would be up to the value which had been set upon them by Mr. Digby Seymour. His last word was, husband your resources till you see that these Provisional Orders are of great value.

The Chairman said that providing the shareholders offered no obstacles to passing the report that day the board would meet them in regard to the appointment of a committee. But they would oppose the amendment. (What of that; you are our servants.") The Chairman said that voice was only speaking for his own faction; not *all* present were with him. The board would oppose the motion for the committee of investigation in the terms in which it was proposed. If the shareholders would pass the report and accounts then the board would agree to the proposal for a committee of conference. ("No, no.") The Chairman then proposed "That a committee of conference be appointed—("No, no")—who shall have free access to the records and documents of the company, including the cases of counsel's opinions referred to in the report, and examine the accounts to November, 1883, and shall make a report, and embody in such report conclusions that they may come to, and if, in the event of their being then dissatisfied, they shall be at liberty to call a general meeting of the shareholders."

Mr. Seaber, holder of 100 original shares, urged that the committee be an independent one, for he was bound to say he thought the balance-sheet would be criticised.

The Chairman then put the amendment as given above.

Mr. Borrer pointed out that the employment of solicitors, accountants, electricians, and so on, would cost money. He did not know whether the shareholders cared to spend money thus.

Mr. Bell, the mover of the amendment, was willing to strike out the clause referred to; he only put it in in order that the inquiry might be a thorough and exhaustive one.

The Chairman: It has been suggested to me that this committee should be called a committee of conference. ("No, no; investigation.") Well, gentlemen, this measure will entirely destroy the prestige of this company—("Where is it?") —and will end in the liquidation of this company. (Hear, hear.)

Mr. Talbot suggested that no person holding less than 250 original shares should be on the committee.

The amendment, as altered, with the omitted clause, was then put to the meeting, and carried by a large majority.

The Chairman: We demand a poll. (Cries of "Shame.")

Mr. Brown (the solicitor who prepared the case for counsel) urged the importance of appointing gentlemen of influence on the committee. It mattered not by what name the committee was called; all they wanted were the facts. ("That's what we cannot get.") He thought the appointment of a committee of investigation was against the interests of the company. Whether they passed the balance-sheet or not to-day mattered very little, so long as they got an influential committee to look into the matter, and their representations would be respected by the general body of shareholders. He was sure the directors generally met the wishes of their shareholders; and if the board were to resign, and they had no one to take their places at the present moment, it would not be to the best interests of the shareholders. Although a large number of persons sent proxies and were not present, their opinion was worthy of respect, for they held a very large stake in the company.

Mr. Seaber asked whether it was understood that the board objected to the balance-sheet standing over till the committee had made their report. He could not see why it should not be, if they would meet the wishes of the company. Do not let the committee be hostile.

The Chairman: In speaking of the accounts, do you speak of the report also?

Mr. Seaber: Yes, sir.

The Chairman: I think you could hardly have caught the terms of the amendment. It says that the report and accounts are most unsatisfactory. That I never will submit to. The poll will be taken to-morrow between 2 and 4.

A Shareholder: You said the amendment was carried.

The Chairman: I said the show of hands is in favour of the amendment, and demanded a poll directly.

The Shareholder: No, sir; you said carried.

The Chairman then attempted to put the amendment as a substantive motion.

Mr. Poole said he was willing to agree to the altering of the first part of the amendment, adjourning the consideration of the accounts until the committee had reported.

Mr. Brown said if the shareholders did not pass the report, the directors could not go forward in their arrangements. He did not think the adopting of the report would lead the shareholders into participating in what had been done in the past. The actual conduct of the business had not, it is true, been satisfactory up to the present moment. They had been discussing the formation of the company. He did not think there was anything to complain of, beyond a mistaken policy, in what the directors had done during the past twelve months. The shareholders must adopt the agreement with the Brush Company for the modification of their license; if not, they must employ other systems, and make the Brush Company a present of what they gave them £235,000 for. A poll was demanded, and if that were carried against them, the committee of investigation would be simply negatived, and they would be left without a voice in the affairs of the company until this time next year. He was sure the board had got proxies enough to carry this point. Why not take what he ventured to think was the only practical outcome, namely, let the committee check what had been done in the past, and give them better information to work on in the future?

Mr. Pollock said if a release were granted to the Anglo-American Brush Corporation, he understood, on no less an authority than that of Mr. Webb himself, that they would condone their claims upon all other parties. He also could show the meeting that the proposed arrangement with the Hammond Company was one which should not be adopted by any means.

Mr. Borrer said the board held more proxies than the shareholders. (Cries of "Shilling shares.") The board wished to carry the report in order to complete the arrangements they had in view.

Mr. MacMillan said he joined Mr. Poole for the sake of getting an investigation. He would recommend the course suggested, of assenting to the report being passed, leaving the question of accounts in abeyance.

The Chairman then put the amendment as a substantive motion, as altered, as follows:—"That the *report* of the directors be and is hereby approved and adopted, and that the consideration of the accounts be adjourned until after the committee of investigation had made their report; and that a committee of shareholders be appointed to investigate the affairs and prospects of the company, and the circumstances attending its promotion and formation, with full power to examine the officers of the company, past and present, and that such committee do report the result of their investigations and recommendations to the shareholders as soon as practicable."

The meeting being about to elect a committee of five *original* shareholders,

Mr. Hammond thought recent large buyers should not be so slighted.

The following committee of original shareholders were then nominated after some consideration:—Mr. H. Hucks Gibbs (1,000 shares), Mr. Lawrence Engle (500 shares). Mr. Peebles, Mr. Andrea, and Admiral Inglefield.

The Chairman then proposed the re-election of the auditors, Messrs. Price, Waterhouse & Co:, which was seconded by Mr. Roberts; and the proceedings shortly afterwards closed amid confusion, after a vote of thanks to the chairman had been proposed by Mr. Talbot.

Great Northern Telegraph Company.—The half-yearly interim dividend on the shares of the company, at the rate of 5 per cent. per annum, will be paid on the 1st of January, by Messrs. C. I. Hambro and Son.

Eastern Extension, Australasia and China Telegraph Company, Limited.—The directors have declared an interim dividend for the quarter ended the 30th September last of 2s. 6d. per share, tax free, payable on the 15th of January, 1884. The coupon on the company's Five per Cent. Australian Government Subsidy Debentures, due on the 1st January next, will be paid by Messrs. Barclay, Bevan, & Co. Coupons must be left three clear days for examination.

The Eastern Telegraph Company, Limited.—This company announces the payment, on January 15th next, of a dividend of 3s. per share on the preference shares, less income-tax, for the quarter ending the 31st inst., and an interim dividend of 2s. 6d. per share, in respect of profits for the quarter ended the 30th September last, with the bonus of 1s. per share, for the half-year ending that date on the ordinary shares, free from income-tax, making a total dividend for the half-year at the rate of 6 per cent. per annum.

LATEST QUOTATIONS.

Authorised Issue.	Share.	Name.	Paid.	Closing Quotations, Dec. 19.	Business Done.
		ELECTRIC LIGHT.			
40,000	10	Anglo-American Brush Co.	8	2¼ - 2⅝	
		Do. Do.	10	4½ - 5	
50,000	5	Australasian E. L., Power & Storage Co.	3	⅛ - ¼	
24,900	10	British Insulite Co., Ld., "A" Shares	5	1 - 2	
30,000	5	Brush Elec. Lt. & Power Co. (Scotland)	2½	¾ - ⅞	
25,000	5	Gt. Western Electric Light & Power Co.	2½	¾ - ⅞	
24,980	5	Hammond Elec. Lt. & Power Sply. Co.	5½	1 - 1¼	1⅛-1-1⅛-1.
40,000	5	Indian & Ori. Electl. Storage Wks. Co.	2	..	
250,000	1	Maxim-Weston Elec. Lt. & Power Co.	1	1/16 - 3/16	
100,000	5	Metrop. Brush Electric Lt. & Power Co.	3	..	
40,000	5	Pilsen-Joel & Gen. Elec. Lt. Co.	2½	..	
20,000	5	S. African Brush Elec. Lt. & Power Co.	2½	..	
100,000	5	Swan United Electric Light Co., Ld.	2½	1 - 1¼	1⅛.
		TELEGRAPHS.			
1,892,480*l.*	Stk.	Anglo-American, Limited	100	43¾ - 44¼	
2,553,760*l.*	Stk.	Do. Pref. } Del. receiving no div. until	100	73½ - 74¼	74¼ ¼.
2,553,760*l.*	Stk.	Do. Def. } 6 p. c. paid to Pref.	100	14 - 15	
130,000	10	Brazilian Submarine, Limited	10	10¼ - 10⅝	10¼.
16,000	10	Cuba, Limited	10	10¾ - 11¼	
6,000	10	Do. 10 per cent. Preference	10	17 - 18	
13,000	10	Direct Spanish, Limited	9	4¾ - 5	
6,000	10	Do. 10 per cent. Preference	10	15 - 16	
65,000	20	Direct United States Cable, Ld., 1877	20	11 - 11¼	
100,000*l.*	100	Do. 6 per cent. Deb., repayable 1884	100	100 -105	
380,000	10	Eastern, Limited	10	10¼ - 10⅝	10⅜.
70,000	10	Do. 6 per cent. Preference	10	13 - 13½	
232,000*l.*	100	Do. 6 do. Debs., repayable Oct. 1883	100	..	
200,000*l.*	100	Do. 5 do. do. Aug. 1887	100	101-104	
200,000*l.*	100	Do. 5 do. do. Aug. 1899	100	104-108	
250,000	10	Eastern Exten., Australasia & China, L.	10	11¼ - 11⅝	11¼-⅜.
320,000*l.*	100	Do. 6 p. c. Debs., repayable Feb. 1891	100	108 - 111	
500,000*l.*	100	Do. 5 p. c. (Aus. Gov. Sub.) Deb. 1900	100	103 - 107	104½.
140,000*l.*	100	Do. do. reg., repayable 1900	100	103 - 107	
100,000*l.*	100	Do. 5 per cent. Debenture, 1890	100	101 - 104	
550,000*l.*	100 / 100	Eastern & South African, Ld., 5 p. c. } Mort. Deb. Rg. redeemable 1 Jan. 1900 }	100	103 - 107	
	100	Do. do. do. To Bearer	100	103 - 107	
22,050	10	German Union Telegraph & Trust, Ld.	10	10 - 10⅛	
250,000	10	Globe Telegraph & Trust, Ld.	10	7 - 7⅛	7⅛.
250,000	10	Do. 6 per cent. Preference	10	13 - 13⅛	13-⅛.
150,000	10	Great Northern	10	13 - 13⅛	13.
100,000*l.*	100	Do. 5 per cent. Debentures	100	102 -105	
300,000*l.*	100	Do. 5 per cent. Debentures	100	102 -105	
81,200	10	India-Rubber, Gutta-Percha, & Tel. Wks.	10	29 - 30	30-29⅞-30-⅛.
100,000	100	Do. 6 per cent. Debs., 1886	100	102 -105	
18,000	25	Indo-European, Limited	25	31½ - 32½	
40,000	10	London Platino-Brazilian, Limited	10	3 - 3½	
12,000	10	Mediterranean Extension, Limited	10	1¾ - 2	
3,200	10	Do. 6 per cent. Preference	10	2 - 4	
10,000	8	Reuter's, Limited	8	8⅞ - 9¼	
338,225*l.*	Stk.	Submarine	100	206 -210	204.
75,000	1	Do. Scrip	1	1⅞ - 2⅛	
4,200	Cert.	Submarine Cables Trust	100	102 -105	
57,330	12	Telegraph Construction and Mainten.	12	35½ - 36⅜	
150,000	100	Do. 6 per cent. Bonds, 1884	100	101 -103	
186,750	5	Do. 2nd Bonus Trust Cert.	2¼	1¼ - 1⅝	1⅝.
20,000	10	West Coast of America, Limited	10	5 - 5¼	
150,000*l.*	100	Do. 8 per cent. Debs.	100	108 -110	
45,791	15	Western and Brazilian, Limited	15	5¼ - 5⅝	
24,119	7½	Do. Preferred	7½	4 - 4⅛	
24,119	7½	Do. Deferred	7½	⅜ - 1	
200,000*l.*	100	Do. 6 p. c. Debs. "A" 1910	100	103 -107	
250,000*l.*	100	Do. 6 p. c. Mort. Deb. B. '80, red. Feb. 1910	100	97 -100	
1,500	$1,000	Western Union 7 p. c. 1 Mort. (Rg.) Bds.	$1,000	119 -121	
1,039,000*l.*	100	Do. 6 per cent. Sterling Bonds	100	102 -105	
88,321	10	West India and Panama, Limited	10	1⅛ - 1⅛	1.
34,563	10	Do. 6 per cent. 1st Preference	10	7⅛ - 8	
4,669	10	Do. 6 do. 2nd do.	10	5½ - 6	5⅝.
		TELEPHONES.			
224,850	1	Con. Tele. & Mainten., L., Nos. to 154,165	1	⅛ - ¼	
225,000	1	Oriental Tele. Co., Nos. 80,001 to 300,000	¼	⅛ - ¼	¼.
100,000	5	United Telephone Co.	5	8 - 8⅛	
20,000	5	Do. New, issued 2 p.m.	2	..	

TRAFFIC RECEIPTS.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending 14th December, were £2,146, after deducting the "fifth" of the gross receipts payable to The London Platino-Brazilian Telegraph Company, Limited.

The Brazilian Submarine Telegraph Company, Limited. The receipts for the same week amounted to £2,838.

NEW PATENTS—1883.

5676. "Improvements in mariners' compass and in the means of ascertaining and correcting its errors." Sir W. THOMSON Dated December 8.

5717. "Electric low-water alarms for steam boilers, applicable also as a thermo-electric alarm." A. M. CLARK. (Communicated by T. McKenna and H. Carley.) Dated December 12. *Complete.*

5718. "Means for working and interlocking railway signals by electricity." S. C. C. CURRIE and J. A. TIMMIS. Dated December 12.

5733. "Obtaining electric force or power." F. H. GOSSAGE. Dated December 13.

5736. "Dynamo-electric machines." P. W. WILLANS. Dated December 13.

5737. "Electric batteries." A. C. HENDERSON. (Communicated by J. B. G. Vauzelle.) Dated December 14.

5741. "Secondary batteries or electrical accumulators." J. S. SELLON. Dated December 14.

5749. "Carbons for electric lamps." C. H. F. MULLER. Dated December 15.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1883.

1756. "Meters for electricity, &c." S. PITT. (Communicated from abroad by J. Cauderay, of Lausanne.) Dated April 7. 6d. Relates to the apparatus described in the No. of the ELECTRICAL REVIEW for September 15th, 1883.

1791. "Application of electricity to vehicles, on tram and railways, &c." F. WYNNE. Dated April 9. 6d. Relates to improvements in the method of applying electrical currents generated by any means to the propulsion of vehicles.

1801. "Conductors of electricity." J. G. PARKER. Dated April 10. 2d. Has for its object to reduce the resistance encountered by an electric current while following a metallic conductor, and the loss of current resulting from such resistance. For this purpose the inventor gives to the metallic conductor such a cross section, that the insulating medium touches the conductor only along a number of ridges or wings, instead of being in contact with the same on its entire circumference, and that the metallic surface of the conductor is increased, as compared with the ordinary circular cross-section. *(Provisonal only.)*

1803. "Dynamo-electric machines, &c." P. M. JUSTICE. (Communicated from abroad by —— Keegan, of America.) Dated April 10. 4d. The object of this invention is first to reduce the amount of power required to work a dynamo-electric machine for the generating of an electric current, by changing the polarity of the instant poles at the time of motion without any disruptive discharge, and second to avoid the production of secondary induced currents in the wire coil of the induced magnet and inducing magnet. The second part of this invention consists in a special construction of the poles of the magnets both inducing and induced, whereby the poles of one are made to revolve between and in close proximity to the poles of the other and the magnetic force is exerted more nearly in line parallel to motion of rotation. *(Provisional only.)*

1805. "Electric pile." J. C. MEWBURN. (Communicated from abroad by M. Azapis and P. Azapis, both of Paris.) Dated April 10. 4d. The improved electric pile which forms the subject of the present invention differs from those generally employed by its special form, the object of which is to increase its surface, and by the employment of ordinary sulphuric acid (acidum sulfurum dilutum) for the porous diaphragms or vessels. The pile which has a diameter of say 9 centimetres (about 3½ inches) and a height of say 24 centimetres (about 9½ inches) is composed of four porous diaphragms or vessels into each of which is inserted a piece of carbon of a diameter one or two centimetres less than that of the diaphragms. Each of the diaphragms carries externally a semi-cylindrical piece of zinc of the same height as the porous vessels. The carbons are connected together by a single metallic piece and the zinc pieces by another metallic piece. Into an outer vessel a solution of a suitable salt, by preference sea salt or salt of ammonia, is introduced. Lastly, into the porous vessels are placed sulphuric acid at 25 to 45° and 5 per cent of ordinary nitre or nitric natron (natre nitrique) or nitric acid.

1812. "Electric lamps, &c." H. EDMUNDS, Jr. Dated April 10. 10d. The insulated wires leading the electric current to the lamps are received in metallic cases to prevent injury or accident from fire. The cases are formed in two parts, the cover being applied after the wires are in place. Where the wires cross each other and where branch wires are taken off, a junction box of insulating material is used and a removable portion is perforated for the passage of the conductors in such a manner that the conductors are kept at the proper distance from each other. Curved cases and T connections are made of two separable parts and the connections of branch and main wires are made by channelled clamping plates. To prevent accident from short circuiting and heating of any wire, the inventor uses a circuit fuse composed of a layer of mica or similar insulating material with lead or other easily fused metal upon its surface, so that when the current becomes too great and liable to heat the wires, this circuit fuse melts and the circuit is broken; the melting foil contracting into globules that adhere to the mica or other insulating material instead of falling in a melted state as heretofore usual. The lamp itself is of glass with the incandescing filament within it, and with electroliers having imitation candles, the glass for holding such incandescing filament is in the shape of the flame of a candle. The exhausted glass is supported upon a spring: the contacts for the wires are made by conducting pins inserted into holes in insulating material into which holes the conducting wires pass. At the joints in the brackets or electroliers supporting the lights there are circular spring contacts which allow the brackets to be turned around partially or entirely without breaking the electric contact. The circuit is closed or broken by a circular ratchet having alternate conducting and non-conducting teeth that are brought into contact with pins or electrodes in the circuit. The wires pass through pipes similar to those used in gas fixtures, and the switch which turns the current on or off is to take the place of the plug in the gas cock. The circuit fuse before named is to be introduced at the wall plate supporting the bracket. In order to make a very reliable switch for turning the electric current on or off the inventor sometimes uses two springs upon an insulated plate with a metal key between them having an insulated handle. When turned so that the edges press against the springs the electric contact and circuit are complete and when turned the other way the contact is broken and one of the springs holds the key from turning accidentally. At the base of the electric lamp there is an insulating block, a locking device to hold the base into a cup, and the electric circuit is through metal studs and spring contacts, and in some instances these devices also are used for making and breaking the electric circuit by giving a partial rotation to the base of the lamp.

1814. "Meter for electric currents." A. M. CLARK. (Communicated from abroad by G. Hochreutiner and A. Boucher, both of Lausanne.) Dated April 10. 8d. Relates to a meter for electricity, wherein the measure of the current which traverses the line is denoted by means of indications furnished by the gases resulting from the electrolysis of acidulated water, or other suitable electrolytic solution, these gases acting mechanically on appropriate registering apparatus, such as ordinary or electrical machine-counters or gas meters, and the like.

1829. "Electrical signalling apparatus, &c." B. J. B. MILLS. (Communicated from abroad by J. U. Mackenzie, of America.) Dated April 11. 8d. The object of one part of this invention is to produce means for transmitting signals electrically which will be simple, cheap, compact, and durable in construction and reliable in operation. The features of the invention are applicable to signal boxes of various constructions, working with the circuit either closed or open normally; to those adapted to transmit any one of a number of signals forming a code, as well as to boxes transmitting a fixed signal as well as any one of a code of signals.

1832. "Incandescent electric lamps." J. W. SWAN. Dated April 11. 4d. In the manufacture of incandescent electric lamps, it is usual to employ platinum wire as the conductor which passes through the glass and is sealed into it. On account of the great cost of platinum this wire is made as thin as possible, and, in consequence, some trouble has been occasioned by the tendency of the thin wire to break when bent or strained, during the process of making the attachment to it of the outward conductor or lamp holder. Now this invention consists in overcoming this defect by depositing copper or other metal, by the well-known electrotype process, around the projecting platinum, whether in the form of a loop-pin, or any other form, so as to strengthen it and facilitate the making a firm attachment of the lampholders or conductors. The same object may be effected by means of solder, which is applied to the protruding platinum so as to increase its strength and facilitates the attachment of the external conducting wires, or a plate, cap, hook or loop of brass, or other suitable metal, may be soldered to the protruding platinum for the purpose of effecting the same object.

1848. "Electric lamps." A. PARTZ. Dated April 12. 2d. The invention consists, first, in the combination, in an electric lamp, of a copper plated or otherwise metalized stick of carbon, an upright metallic tube holding the same, and being just wide enough to allow it freely to slide therein, and a piece of carbon in the shape of a cone, or presenting a plain or curved incline of about 45 degrees, on which the stick of carbon stands, so that through its tendency to slip down the incline it is always kept sufficiently braced in the tube to preserve the necessary contact for the passage of the electric current, the positive conductor of which is made to communicate with the said tube, and the negative with the said cone; second, in an electric twin-lamp in which two copper-plated, or otherwise metalized sticks of carbon, movable in upright metallic tubes, stand at opposite sides, or nearly so, upon the incline of the carbon cone, so that, electric conductors being attached as aforesaid, two lights are produced on the face of the same negative pole, and thus the lateral shadow caused by a single light is avoided. *(Provisional only.)*

1871. "Electric lamps." A. P. LUNDBERG. Dated April 13. 2d. Has for its object an improved construction of electric lamp and relates more particularly to arc lamps. *(Provisional only.)*

1879. "Apparatus for electric signalling and alarm giving." J. H. JOHNSON. (A communication from abroad by A. Jeanjean and L. J. H. Eon.) Dated April 13. 6d. Relates to the apparatus described in the number of the ELECTRICAL REVIEW for December 15th, 1883.

1889. "Electric cables or conductors and machinery for manufacturing the same." W. R. LAKE. (Communicated from abroad by W. J. Philips and G. L. Kitson, of America.) Dated April 13. 6d. Has for one of its objects to provide an improved electric cable or conductor for submarine, underground, or other purposes, consisting of a wire or cable which is first coated with Burgundy pitch, then wrapped with a covering of cotton wool or asbestos over which a layer of resin is placed and the whole encased in a covering of lead.

1895. "Generating and applying electricity for medicinal or other purposes, &c." R. V. ASH. Dated April 14. 4d. The object and design of this invention is to afford a more perfect means than has yet been attained for the production of electric and magnetic currents and discharges in and upon substances and surfaces of wearing apparel worn by human or other living beings, in such a manner as to ensure the production of currents or discharges in any required direction and with the proper power over the whole surface to be treated.

1952. "Apparatus for transmitting electrical signals at a distance." C. D. ABEL. (Communicated from abroad by Bruno Abdank-Abakanowicz, of Paris). Dated April 17. 6d. Relates to the apparatus described in the No. of the REVIEW, for August 18th, 1883.

CORRESPONDENCE.

The Electric Light at the Gaiety Theatre, Glasgow.

Referring to your description of the lighting of this theatre with the electric light, we notice that you have omitted altogether to state that the work was carried out entirely by the Jablochkoff Electric Light and Power Company, and as the result of the recent trial proved the installation to be throughout a perfect success, it may be interesting to your readers if we take this opportunity of stating how it was conducted.

The installation consists of 280 incandescent lamps of 20 candle power each, three Jablochkoff patent arc lamps of 800 candles, and nine Jablochkoff patent arc lamps of 400 candle power. Around three tiers of the auditorium are placed 40 incandescents, in the pit 16, corridors and gallery have 12 lights, main entrance 30, the smoking, crush, and refreshment rooms employ 26, the dressing rooms, green room and offices a further 16, while upon the stage are 40 as footlights, with also four batteries containing 24 lights each.

Three of the large type (800 C.P.) of arc lamps are placed in the centre of the ceiling, one in each of the four docks of the stage, and the remaining five are outside of the theatre.

The motive power is obtained from two Marshall 16-horse power steam engines of the semi-portable type, which drive one alternating Gramme dynamo machine connected up for a quantity current to supply the incandescent lamps, and two Jablochkoff dynamos, size "B," supplying the current to the arc lamps. Arrangements are perfected whereby the lights in any circuit can be independently lowered, or raised at pleasure.

We believe this is the first instance, in this country, of the lighting of any theatre by both arc and incandescent systems at once.

Fras. R. Reeves,

Secretary and General Manager,
The Jablochkoff Electric Light & Power Company, Ltd.

1, Great Winchester Street Buildings,
London, E.C., *Dec.* 12*th*, 1883.

Practical Electrical Units of Measurement.

In Bromley Holmes' "Practical Electric Lighting," page 18, we are told "The 'Watt,' or practical unit of *work* (or rather of the *rate of doing work*) is equal to 10 million ergs (10^7 absolute C.G.S. units) per second or to the work produced in that time by an ampère of current of E.M.F. of one volt. Again, on page 22—

"$W = C\,E$ or $W = C^2 R$.
Where C = current in ampères,
„ E = electromotive force in volts,
„ W = work in *Watts*."

Turning to "Rankines Rules and Tables," sixth edition, page 303, we there find the Watt defined as the "rate of doing work when an ampère passes through an ohm, and it is equal to 10^7 ergs, or a joule per sec ($\frac{1}{746}$ of a horse-power nearly)."

Is there not a mistake in one or other of these definitions?

Again, in "Bromley Holmes," at the foot of page 20 "The joule, or unit of *heat*, is the amount required to raise *one gramme* mass of water *one degree centigrade*, and is equal to the work of 42 million ergs, or $3\frac{1}{10}$ foot lbs. The work required to raise 1 lb. weight of water one degree Fahrenheit is equivalent to 772 foot lbs."

Turning again to "Rankine's Rules and Tables," foot of page 303, we have "*Heat or Work*" = W. "The joule is the work done or heat generated by a Watt in a second, *i.e.*, the work done or heat generated in a second by an ampère flowing through the resistance of an ohm, or the heat generated by a coulomb running down through a difference of potential of 1 volt." "It is, therefore, the amount of heat equivalent to 10^7 ergs. Assuming joules equivalent = 42 million, it is the heat necessary to raise ·238 gramme of water 1° C."

Then again there is a very considerable difference between the two definitions.

Perhaps you, or some of the readers of the ELECTRICAL REVIEW, will kindly say which of the definitions are correct.

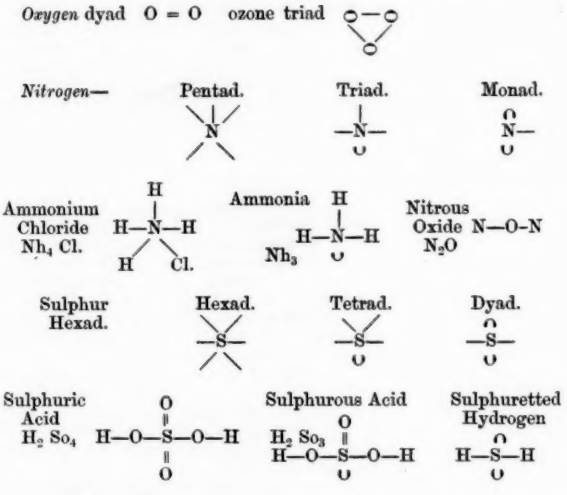
It is very perplexing to a student to have such different definitions of the same things given by standard text books.

A Student of Engineering.

Dec. 15*th*, 1883.

Atomic and Equivalent Weights of Elements.

In your issue of December 1st I notice a letter from Mr. Carswell referring to the valency and chemical equivalents of certain elements, and in last week's a reply, which, while giving extracts from various books, does not give any real explanation of these apparent differences. I will therefore, with your permission, give a few examples, and endeavour to explain the cause in the manner accepted by most chemists. Oxygen is a dyad, but in its allotropic form of ozone it exists as a triad. Nitrogen in chloride of ammonium (Nh_4 Cl) is a pentad, in ammonia (Nh_3) a triad, and in nitrous oxide (N_2 O) a monad. Carbon and tin are tetrads or dyads, while sulphur, selenium and tellurium are either hexads, tetrads or dyads. It is found that this variation in atomicity always takes place by the disappearance or development of an even number of bonds. These remarkable facts may be explained in a very simple way, viz., that one or more pairs of bonds belonging to one atom of the same element can unite, and, having saturated each other, become, so to speak, latent. This can be graphically shown as follows :—



Adopting this hypothesis, it is convenient to consider the maximum number of bonds of an element, as its absolute atomicity, the number of bonds united together as its latent atomicity, and the number of bonds actually engaged in connecting it with the other elements of a compound—its active atomicity. Thus, in sulphuric acid (H_2 So_4) the absolute and active atomicities = 6, therefore the latent atomicity = 0. In sulphurous acid (H_2 So_3) the active atomicity = 4, consequently the latent = 6—4 = 2. In sulphuretted hydrogen (H_2 S) the active and latent atomicities are respectively 2 and 4. I think this explanation is sufficiently clear, and will dispel Mr. Carswell's doubts on the subject. I must apologise for trespassing so much upon your valuable space.

William E. Dawson.

Laboratory,
7, Jeffrey's Square, London, E.C.,
December 11*th*, 1883.